Contextual factors influencing the implementation of sustainable supply chain practices: An empirical study on product manufacturing companies in the BENELUX region

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I cannot think of a better way to conclude this acknowledgment than mentioning the quote which kept me going throughout those periods of uncertainties and low,

"It takes a lot of time to be genius, you have to sit around so much and doing nothing, really doing nothing" – Gertrude Stein.

M.S. BHAT

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Executive summary

With the rising global pollution and rising concern over sustainable operations, manufacturing companies are under tremendous pressure from its stakeholders to adopt Sustainable Supply Chain Management (SSCM). However, companies in addressing SSCM, largely focus on the economic aspects neglecting the other two crucial pillars of sustainability. To tackle this issue and promote the TBL approach in SCM, several research studies describe frameworks for environmental and social sustainability practices and highlight its influence on economic performance. Despite these efforts, practical implementation of environmental and social sustainability practices is lagging.

Studies have been conducted to explore the influencing factors for implementation of SSCM. Yet, a little is known about the factors influencing the implementation of individual sustainability practices. Additionally, many of the influencing factors are suggested to be contextual. To address the issue and close the research gap, this study proposes to explore the contextual factors influencing the implementation of environmental and social sustainability practices. Therefore the main research question of this study is: *What are the factors that significantly influence the implementation of sustainable supply chain practices corresponding to environmental and social pillars, in product manufacturing companies of the BENELUX region?*

The process of answering the research question involves three important phases: a) A comprehensive literature survey to derive a set of practices corresponding to environmental and social sustainability in SCM and a set of factors that are indicated to influence the implementation of sustainability practices b) Development of survey questionnaire targeted at measuring the implementation of practices and factors derived from a literature survey, and data collection c) Statistical analysis of the collected data.

A comprehensive literature survey resulted in the identification of 8 management practices and 5 main categories of factors. Based on this a survey questionnaire was developed and shared among target respondents using email-based survey system. This resulted in the collection of data from 112 product manufacturing companies of the BENELUX region.

Data collected were subjected to preliminary analysis. This involved a Principle Component Analysis (PCA) on 2 of the 5 main categories of factors due to multi-dimensionality. PCA of 2 main factors lead to 7 new factors and along with 3 original factors, all 10 factors were carried to data analysis.

Series of 8 binary logistics regressions, one for each of the practices were performed. Additionally, a multiple regression analysis was conducted to explore the influence of factors on the level of implementation.

Regression results show that 9 out of 10 factors significantly influence the implementation of at least one of the sustainability practices. Sustainability Policies and Objectives (SPO) being the major contributor shows significant influence towards 4 of the practices and relatively low significant influence on 3 other practices. However, Downstream Supply Chain Factor (DSCF) do not significantly influence the implementation of any of the practices.

Based on data analysis results, a detailed discussion is conducted and answer to the main research question is provided. Next, the limitations of the research study, recommendations for future studies are provided. Finally, a personal reflection and managerial implications are provided.

Table of content

Acronyms

AR	Availability of Resources
B2C	Business to consumer
CDI	Community Development and Involvement
CIBSE	Chartered Institution Building Services Engineers
CS	Competitive Strategy
CRM	Cross-functional Collaboration and Risk Management
CSI	Corporate Social Image
CSR	Corporate Social Responsibility
DE	Descriptive Evidence
DEMATEL	Decision Making Trial and Evaluation Laboratory Model
DM	Diversity Management
DSCF	Downstream Supply Chain Factors
ECC	Environmental Customer Collaboration
EGSCM	External Green Supply Chain Management
EP	Environmental Procurement
GIF	Government and Institutional Factors
IGM	Internal Green Management
IGSCM	Internal Green Supply Chain Management
IR	Investment Recovery
ISM	Information and Supplier Management
KMO	Kaiser-Meyer-Olkin
MNE	Multinational enterprise
NGO	Non-Government organization
OR	Organizational Readiness
PCA	Principal Component Analysis
RDT	Resource Dependency Theory
SCM	Supply Chain Management
SM	Safety Management
SPD	Sustainable Product Design

STH	Stakeholder related factors
SPO	Sustainability Policies & Objectives
SS	Statistical Significance
SSCM	Sustainable Supply Chain Management
TBL	Triple Bottom Line
TCE	Transaction Cost Economics
TE	Training and Education
USCF	Upstream Supply Chain Factors
VIF	Variance Inflation Factor

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Chapter 1. Introduction

The role of the manufacturing industry and its supply chain is becoming more and more prominent with the rising human population. At the same time, the environmental impact of manufacturing industry towards global warming and depletion of non-renewable energy sources has increased the necessity of incorporating sustainability in its operations (Ageron, Gunasekaran, & Spalanzani, 2012; Klassen & Vereecke, 2012).

Sustainability in business operations can be better understood with the framework of Triple Bottom Line (TBL). Triple bottom line approach was first introduced by a business author named John Elkington in his publication of (Elkington, 1997) who emphasized the importance of social and environmental dimensions in sustainable development and called for an integrated approach during sustainability implementation. According to Elkington (2004), most companies aiming to improve their financial health focus mainly on economic sustainability neglecting the contributions of the other two elements on economic performance. Studies have been conducted to explore possible cause for poor adoption of TBL approach. Hammer & Pivo (2017) expresses the lack of understanding of TBL concepts as the main roadblock to its implementation. Also, it has been expressed in some studies that managers face the problem of measuring TBL performance with a common unit and fail to incorporate TBL concepts into their business operations (Hsueh, 2014; Slaper, T.F. & Hall, 2011).

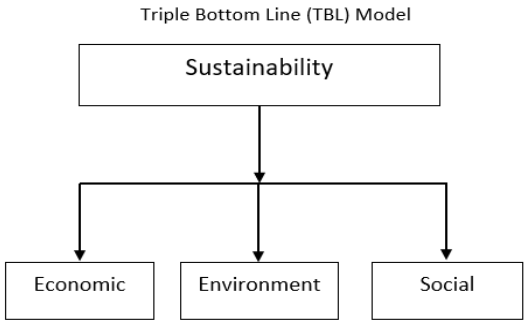

Figure 1.1 Pillars of sustainability

On the other hand, some research works have been carried out to promote the TBL approach. Svensson & Wagner (2015) developed propositions for the implementation of all three pillars of sustainability into business operations and developed an analytical model to measure economic performance. S.L.a & C.D.b (2013) describe how environmental sustainability practices lead to a firm's economic performance improvement.

The original idea of sustainability of business operations is to implement and manage economic, environmental and social efforts in all the company operations in a balanced manner (Hervani, Sarkis & Helms, 2017; Svensson & Wagner, 2015). This evokes a perspective about the TBL approach in supply chain management. Many studies express the benefits of adopting TBL approach in SCM. Biswas, Raj, & Srivastava (2018) have developed an analytical framework for TBL integrated supply chain management and demonstrated that greening and CSR efforts in the decentralized supply chain will enhance the firm's performance. Sancha, Longoni, & Giménez (2015) claims that adoption of social sustainability practices in SCM delivers tangible performance outcomes.

Moreover, the attempts have been also made to explore the significance of TBL in the context of manufacturing SCM. K. W. Green et al. (2013) performed an empirical study on manufacturing organizations and found that the adoption of GSCM practices leads to the improved environmental and economic performance of the company. Drawing from these studies, it can be established that there is a greater advantage of adopting an integrated approach in SCM rather than just focusing on the economic pillar.

However, it is observed that the companies implementing sustainability into SCM, focus only on the economic pillar. Many researchers raise their concern over negligence of environmental and social pillars in supply chain management (Alzawawi, 2013; Morais & Silvestre, 2018; Walker, Di Sisto, & McBain, 2008). It seems that efforts are needed to explore the challenges associated with the inclusion of environmental and social priorities into supply chain operations. Halldórsson, Kotzab, & Skjøtt-Larsen (2009) suggests that there might be differences in the handling of sustainability of SCM between industries, product, and countries and, therefore future researches should focus on identifying the contextual factors of SSCM.

1.1 Problem definition

The existing literature emphasizes the importance of adopting TBL approach in SCM and its positive impact on the economic performance. However, the incorporation of environmental and social pillars in SCM have been ignored by the organizations. Many researchers express their concern over the negligence of these dimensions and suggest that cumulative efforts are needed in this direction. There is a need for a concrete study which explores the contextual factors that influence the implementation of these practices.

1.2 Research gap and research scope

A research study focusing extensively on the implementation of environmental and social sustainability practices is limited. The existing studies explore the factors influencing the implementation of SSCM in general but a study describing a concrete framework for management practices that lead to environmental and social sustainability in manufacturing supply chain and empirically exploring the contextual factors influencing implementation of each of these practices is missing. Also, a study exploring the implementation of environmental and social sustainability practices in the context of product manufacturing companies of the BENELUX region is missing. Therefore this study focuses on bridging above mentioned research gap.

Scope:

Since the benefits of adopting environmental and social sustainability practices in SCM has been expressed in the existing literature, this study intends to explore factors that significantly influence the implementation of these sustainability practices. The measure of the impact of implementation of these practices on the firm's performance is out of the scope of this study. This study focuses on product manufacturing companies, in general, to achieve the required sample size for the empirical study. Exploring the contextual factors for a product-specific manufacturing industry is out of the scope of this study.

Academic relevance:

This study is expected to expand the knowledge on the implementation of environmental and social sustainability practices in manufacturing SCM. Additionally, it gives an understanding of the contextual factors that influence the successful implementation of sustainability practices in the context of The BENELUX. The research study is one of its kind and expected to generate new knowledge. Therefore it is considered to be academically relevant.

Industrial relevance:

The contextual factors identified at the end of the study is expected to aid industrial decision makers during sustainability implementation. It is also expected to give information regarding the present implementation level in the industry which might help managers to compare and calibrate their sustainability efforts with that of a industry.

1.3 Research objective and Research question

To bridge the research gap and to expand the understanding of contextual factors influencing the implementation of sustainable practices, this research study is conducted. The main research objective of this study is

To explore the contextual factors influencing the implementation of practices that contribute to environmental and social sustainability in manufacturing SCM

To achieve the above-stated objective, the main research question of this study is

RQ: What are the factors that significantly influence the successful implementation of sustainable supply chain practices corresponding to environmental and social pillars, in product manufacturing companies of the BENELUX region?

A set of sub-research questions are formulated to assist in answering the main research question.

RQ1: What are the different management practices that contribute to environmental and social sustainability in manufacturing SCM?

RQ2: What are the different factors of sustainability implementation, that can be derived from literature survey?

Chapter 2. Literature survey

2.1 Sustainability of supply chain management: A perspective on environmental and social aspects

In recent times, focus on sustainable supply chain management (SSCM) is increasing to minimize the environmental impact of the product throughout its life cycle (Grekova, Calantone, Bremmers, Trienekens, & Omta, 2016). SSCM is defined as "*the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains*" (Carter & Rogers, 2008,p.368). Although researchers have tried to inculcate supply chain management into the domain of sustainable development (Pagell & Wu, 2009; Rajeev, Pati, Padhi, & Govindan, 2017) they have largely focused on an economic pillar of sustainability. According to Barbosa-Póvoa et al. (2017), many companies focus on the economic aspects of sustainability whereas environment and social dimensions of sustainability have not received much focus. Therefore, it is worthwhile to explore the environmental and social sustainability aspects of supply chain management.

Environmental priority in supply chain refers to the responsible execution of supply chain activities with a focus on reducing the environmental impact and preserving the environment for future generations (Qinghua Zhu, Sarkis, & Lai, 2013). The literature by Laari et al. (2017) has identified supply chain management with environmental priorities as Green supply chain management (GSCM) and stated that it is a combination of environmental management and supply chain management. Zhang et al. (2016) state that Green supply chain management is a building block towards Sustainable supply chain management (SSCM) with a focus on the environmental dimension of sustainability. Furthermore, many studies stress the benefits of adopting green supply chain management. According to Green et al. (2013), the adoption of GSCM practices by manufacturing companies leads to improved environmental and economic performance which in turn influence the operational performance of the company.

Social sustainability of supply chain management refers to those activities that contribute to social welfare by involving in activities that strive to improve working conditions and quality

of life. Yusuf et al. (2013) state that social sustainability is a means to achieve the twin goal of both economic and environmental sustainability. Giddings, Hopwood, & O'Brien (2002) identified social sustainability under two dimensions: human and society. Human dimension refers to activities that promote Individual development (Health, safety and knowledge etc.) whereas societal dimension corresponds to cumulative growth and welfare of the society (ex: Abolition of child labor, equal opportunities, human rights etc).

2.2 Management practices that lead to sustainable supply chain management

The literature on SSCM describes different theoretical frameworks from which sustainability practices can be formulated. Laari et al. (2017) describe two types of theories for deriving sustainable supply chain practices: Transaction cost economics (TCE) and Resource dependency theory (RDT). Transaction cost economics suggests that there are various kinds of costs associated with market transactions and these costs determine the make or buy decisions of the firm. Lu, Wu, & Kuo, (2007) suggests that make or buy decisions can be extended to environmental buyer-supplier relationships. Furthermore, building on the framework of TCE, Vachon & Klassen (2008) in their work mentioned about two types of practices for green supply chain management namely Environmental monitoring and Environmental collaboration with suppliers. Environmental monitoring is an indirect method whereas Collaboration is direct involvement with the suppliers to achieve environmental sustainability goals (Grekova et al., 2016).

On the other hand, resource dependency theory says that firms are dependent on its stakeholders for their resources and capabilities (Pfeffer & Salancik, 1978; Ulrich & Barney, 1984) and will respond to sustainability requirements and pressures. The extent to which buyers can influence the environmental performance of suppliers depends on the bargaining power of the buyer (Min & Galle, 2001). However, the social sustainability of SCM is the least focused area and literature on it is limited. Sancha, Gimenez, & Sierra (2016) suggests that through 'Supplier assessment' and 'Supplier collaboration' social performance of both buyer and supplier company can be improved.

One of the important literature on management practices leading to sustainable supply chain management is by Zhang et al., 2016 which adopts a multi-dimensional approach towards sustainability with an extensive focus on environmental and social pillars. It describes eight different sustainability practices categorized under three dimensions that are tested with data

from 293 Chinese manufacturing companies to be positively associated with SSCM. The three dimensions are, *1) Internal Green Supply Chain Management(IGSCM)* which relates to sustainable activities within firm's organizational environment, measured by, *1a) Sustainable Product Design (SPD) and 1b) Internal Green Management (IGM)*. *2) External Green Supply Chain Management (EGSCM)*, corresponds to sustainable activities external to the organizational boundary, measured by, *2a) Environmental Customer Collaboration (ECC) 2b) Environmental Procurement (EP)* and *3c) Investment recovery (IR)*. *3) Corporate Social Responsibility (CSR)*, this dimension accounts for social sustainability in supply chain and include, *3a) Diversity Management(DM)*, *3b) Community Development and Involvement (CDI)* and *3c) Safety Management (SM)*. These eight management practices are conceptualized as third order construct and are empirically tested for their correlation with the Environmental and Social sustainability of Supply Chain Management (Zhang et al., 2016).

2.2.1 Dimension 1: Internal green supply chain management (IGSCM)

It focuses on improving the operational practices inside the firm boundary to enhance the environmental performance of supply chain (Qinghua Zhu et al., 2013). IGSCM practices reflect a firm's commitment to developing strategies aimed at minimizing the environmental impact of the firm's operations (Zhang et al., 2016). The practices considered are; Sustainable Product Design (SPD) and Internal Green Management (IGM). IGM reflects the activities undertaken in order to promote and commit to the green practices internally and is defined as *''the practice of improving environmental excellence internally through management commitment, employee training, organizational regulation, and cross-functional collaborations*'' (Zhang et al., 2016). SPD aims at the design of sustainable and eco-friendly products. SPD is defined as "*the systematic integration of environmental consideration into the product and process design*"(CIBSE (Chartered Institution Building Services Engineers), 2006; Zhang et al., 2016).

2.2.2 Dimension 2: External green supply chain management (EGSCM)

External green supply chain management refers to activities external to the firm boundary and requires the cooperation of suppliers and customers (Qinghua Zhu et al., 2013). EGSCM is defined as "*the environmental management practices that manage the cooperation with supply chain partners or stakeholders for the environmental objectives and solutions*"(Zhang et al., 2016; Q Zhu, Sarkis, Cordeiro, & Lai, 2008). Practices that contribute to this dimension are Environmental Customer Collaboration, Environmental Procurement, and Investment Recovery. Environmental Procurement focuses on upstream suppliers (Zhang et al., 2016) and is defined as "*the set of purchasing policies held, actions taken, and supplier relationships formed in response to concerns associated with the natural environment*" (Zsidisin & Siferd, 2001, p.69). EP includes activities such as Eco-labels of procured materials, avoiding procurement of environmentally hazardous materials, recyclability of supplied materials and environmental responsibility of suppliers (Nagel, 2000). Environmental Customer Collaboration (ECC) refers to environmental supply chain efforts of a company through collaboration with customers to undertake green production, green packaging and maximization of logistics resources (Zhang et al., 2016). Investment Recovery (IR) is defined as "*management practices that recover and recapture the value of unused or end-of-life assets through sales of excess inventories, scrap and used materials, excess capital equipment, and refurbished products*" (Zhang et al., 2016; Qinghua Zhu, Sarkis, & Lai, 2008b). IR is built upon the frameworks of reverse logistics and includes activities such as recycling of products or components from point of consumption (Lai, Wu, & Wong, 2013), clearing of inventories and scraps (Qinghua Zhu et al., 2008b).

2.2.3 Dimension 3: Corporate social responsibility

This dimension accounts for the social sustainability of supply chain management. Many researchers have indicated the need to focus on the social pillar of sustainability. Zhang et al. (2016) stress the inadequacy of research focusing on management practices that contribute to the social sustainability of supply chain management. CSR can be defined as ''*meeting the economic, legal, ethical and discretionary responsibilities expected by society*'' (Carter &

Jennings, 2004). Chi (2011) suggest that CSR activities will aid in the establishment of socially sustainable supply chain management.

The practices under this dimension are; Diversity Management (DM), Community Development and Involvement (CDI) and Safety Management (SM). DM reflects activities focused on promoting equality by purchasing from minority-owned enterprises (Zhang et al., 2016), the appointment of minority and women supply chain executives and contracting with the minority-owned business enterprise (Inoue & Lee, 2011). SM deals with enforcing safety considerations into the supply chain (Zhang et al., 2016). Under SM, Safety practices among suppliers, safety precautions to ensure the health and safety of employees and safety practices in warehousing are crucial (Ciliberti, Pontrandolfo, & Scozzi, 2008). Community development and involvement (CDI) reflect on the company's efforts to contribute, develop and support the local communities through its social involvement (Zhang et al., 2016).

Deriving from the literature, 8 management practices are considered that are empirically proved to be positively associated with sustainable supply chain management (SSCM). Figure 2.1 summarises these practices.

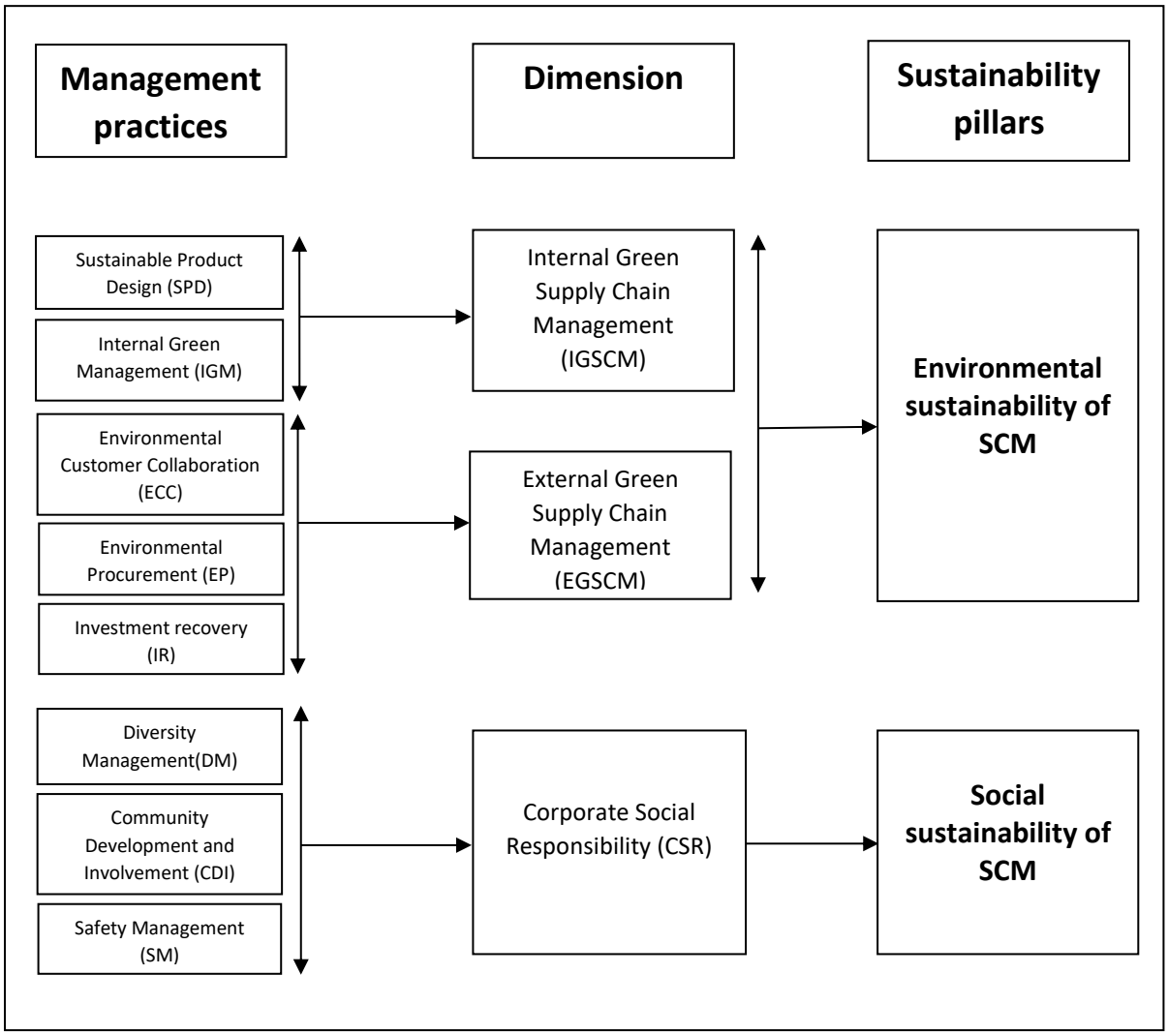

Figure 2.1 Management practices that lead to SSCM

Apart from identifying the sustainability practices that lead to SSCM through literature survey, it is observed that studies highlight the relationship among implementation of GSCM practices. Qinghua Zhu, Sarkis, & Lai (2007) state that all five GSCM practices (IGM, SPD, IGM, ECC, and IR) are interconnected and cannot be implemented by a single function/department rather it requires cross-functional cooperation. Green et al. (2013) claim that internal environmental management and green Information systems are necessary precursors for green procurement, cooperation with customers, eco-design and Investment recovery. Therefore it is suspected that there is a significant correlation between implementation of IGSCM and EGSCM practices. Figure 2.2 depicts the hypothesis drawn on the implementation of GSCM practices.

Hypothesis related to the implementation of GSCM practices:

P: There is a significant correlation between the implementation of internal green supply chain management practices and implementation of external green supply chain management practices.

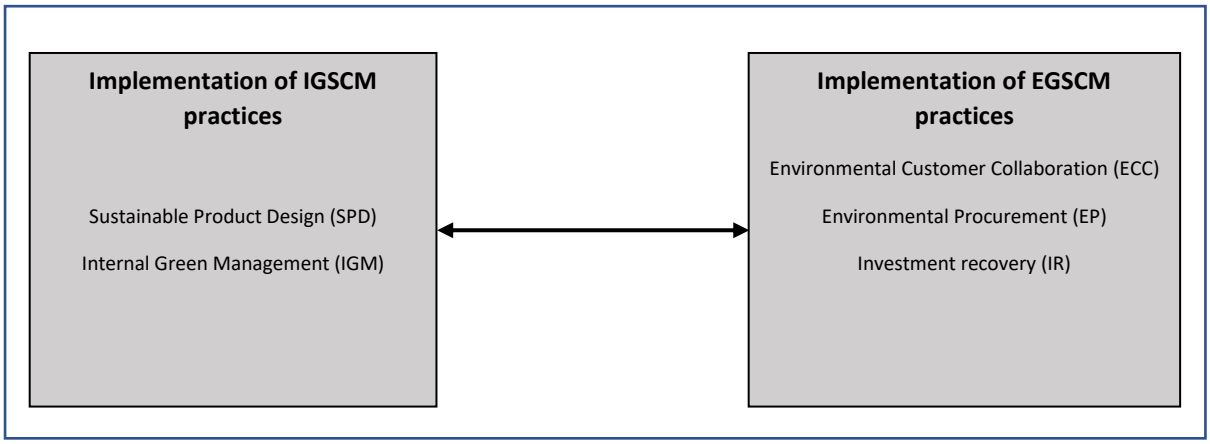

Figure 2.2 Hypothesis for implementation of GSCM practices

2.3 Factors for SSCM implementation

To investigate different factors that influence the implementation of sustainability practices in SCM, the existing body of literature is surveyed. The survey is not limited to any specific context as referring to studies of multiple contexts is thought to broaden the understanding of potential sustainability factors.

Table 2.1 summarises various literature and factors identified from the literature review.

Sl No	Drivers/Barriers	Research Scope / Method	Research Goal	Description	Literature
1	**Barrier:** Lack of knowledge Lack of Governmental support and incentives Stringent administration by authorities	Interview of 30 executives from 20 Chinese MNE's	Challenges of environmental sustainability programs	Lack of correct understanding of environmental and social sustainability and lack of governmental support is the main cause of poor implementation.	(Lai-Ling Lam, 2011)
2	**External drivers:** Competition Market requirement (Consumer pressure) Regulations Public reputation Secondary stakeholder pressure (NGO's and media and society) **Internal drivers:** Ethics and values	Interviews of sustainability managers from 6 different Brazilian companies (Cosmetics Food Automobile LPG)	Factors influencing social sustainability practices	Internal drivers lead to social initiatives through structural collaborations and External drivers lead to social initiatives through information exchange	(Morais & Silvestre, 2018)
3	**Internal Drivers:** Public reputation Policy entrepreneurs The desire to cost reduction **External Drivers:** Regulations Customers pressure Competition Societal pressure (NGO's, public awareness, Consumer demand) **Internal Barriers:** Cost of implementation	Interviews with seven different organizations belonging to Food, Healthcare, Manufacturing, Governmental procurement industries	Drivers and barriers for implementation of environmental supply chain management practices	Various internal and external influencers (drivers and barriers) were identified for implementation of GSCM practices, through interviews of seven different organizations of various industries	(Walker et al., 2008)

	Lack of legitimacy of benefits of sustainability Economic stability **External Barriers:** Regulation Poor supplier commitment Limited supplier base				
4	**Drivers:** Product risk management Collaboration with suppliers Public reputation	Case study analysis of the large chip manufacturing company	Drivers for the implementation of green supply chain management	To better manage risk and to be identified as sustainable organization AMD implemented GSCM practices through supplier collaboration	(Trowbridge, 2001)
5	**Drivers:** Buyer's influence Governmental support Organizational readiness • Availability of resources • Manager awareness • Organizational capabilities	Survey type of research. Data from 142 SME's in South Korea	Drivers for the adoption of green supply chain management practices	This research explores drivers for suppliers to adopt GSCM	(Lee, 2008)
6	Lack of information management system and traceability Lack of top management commitment Uncertainty about economic benefits Poor supplier commitment Lack of governmental regulations and policies	Multi-criteria decision making by 4 experienced evaluators from the cashew manufacturing/processing industry.	Environmental sustainability in SCM	Highly prominent barriers to GSCM implementation were identified with the help of industry experts using multi-criteria decision-making method	(Agyemang, Zhu, Adzanyo, Antarciuc, & Zhao, 2018)
7	Lack of information Lack of top management commitment Lack of regulations and policies The economic condition of the firm The absence of societal pressure Lack of cleaner technology Lack of training and education Customer lack of awareness Outdated resources (Infrastructure)	Literature survey and interview of industry experts; Leather manufacturing industry	Sustainability in Supply Chain Management	Through literature survey and industry experts, a set of factors for SSCM implementation were identified and then subjected to the DEMATEL method to identify high prominence factors	(Moktadir, Ali, Rajesh, & Paul, 2018)
8	Top management commitment Total involvement of employees Training	Survey type of research. Data collected from	Critical factors influencing environmental	Set of critical factors that influence environmental	(Yeo Soo Wee, 2006)

	Green process design Supplier management Performance measurement Information management	186 manufacturing companies (Chemical and electronic)	management practices	practices are established and tested for their validity in the case of manufacturing companies	
9	Customer & social pressure Sustainability culture of the firm Regulatory compliance External stakeholders	Survey type of research with structured questions targeted at manufacturing companies. Data from 244 Indian and 126 Portuguese manufacturing firms	Factors influencing adoption of social sustainability in SCM	Based on stakeholders and institutional theory, four different forces for social sustainability adoption is derived and tested for correlation among different manufacturing companies.	(Mani & Gunasekaran, 2018)
10	**Drivers:** Financial benefits of adopting sustainability Regulations ISO certification to gain reputation Support from suppliers Barriers: Lack of training Lack of Knowledge High costs	Survey type of research. Data gathered from 60 employees of aircraft equipment manufacturing company	Drivers and barriers to the implementation of sustainability in SCM	Drivers and barriers to implementation of sustainability into SCM was explored in case of an aircraft equipment manufacturing company This company had already implemented sustainable development practices during the survey	(Alzawawi, 2013)
11	SCM capability • Cross-functional integration • Collaboration with suppliers • Understanding of environmental issues and impact • Technical skills of purchasing personnel • Detailed purchasing policies and procedures	A survey of 70 operating units within UK Public limited companies	Role of SCM capabilities in the implementation of GSCM practices	Corporate proactive approach and strategic SC management leads to SCM capability building which facilitates environmental sustainability implementation	(Bowen, Cousins, Lamming, & Faruk, 2001)
12	Stringent institutional administration (Corruption)	Case study analysis of the world's largest meat processing	Sustainability of SCM	Lack of strict governmental administration leads to supply chain corruption thereby	(B. S. Silvestre, Monteiro, Viana, & de Sousa-Filho, 2018)

		company (JBS) situated in Brazil		bypassing the sustainability regulations.	
13	Government policies and frameworks Provision of fund and allocation of resources Development of efficient information technology network Training and knowledge to stakeholders	An empirical case-study analysis in agri-food industry supply chain of India	Enablers for sustainability initiatives in SCM	Set of primary enablers were derived through a combination of ISM & DEMATEL techniques and were tested through empirical case study analysis	(Mangla et al., 2018)

Table 2.1 Table showing overview of literature survey conducted on the implementation of SSCM practices

The factors identified are sorted into five main categories based on the relevancy and are Training & education, Competitive strategy, Stakeholders, Organizational readiness and Sustainability policies and objectives.

2.3.1 Sustainability training & education programs

A number of studies (Alzawawi, 2013; Moktadir et al., 2018; Yeo Soo Wee, 2006) highlighted the importance of training and educational activities in the implementation of sustainability practices. Through training & education programs, organizations can educate and engage employees in sustainability initiatives. Few literature identified lack of correct knowledge about sustainability practices (Lai-Ling Lam, 2011), lack of knowledge about economic/financial benefits of sustainability (Agyemang et al., 2018; Alzawawi, 2013; Bowen et al., 2001) and lack of support from middle managers (Walker et al., 2008) as barriers to the implementation of sustainable practices in their respective studies and recommended training and education as a remedy. Additionally, Mangla et al. (2018) recommended training and knowledge development programs for suppliers for behavioral change. So it can be established that Sustainability training & education programs are associated with the knowledge of sustainability practices and their economic benefits, which in turn influences sustainability adoption.

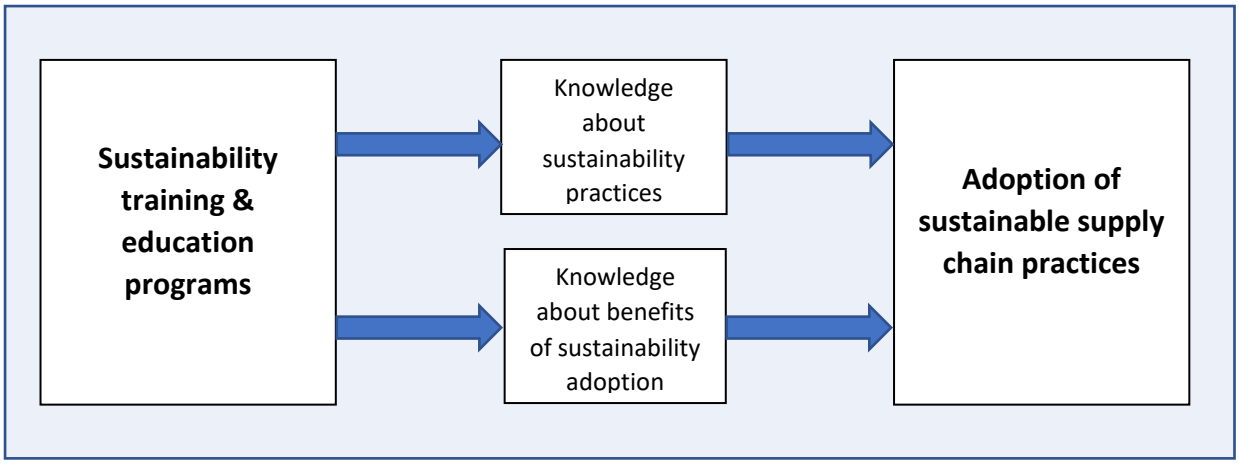

Figure 2.3 Conceptual model of sustainability training and education

2.3.2 Sustainability oriented competitive strategy

Sustainability oriented competitive strategy plays an important role in driving organizations towards sustainability in SCM. Literature such as (Morais & Silvestre, 2018; Walker et al., 2008) suggest that in a high competition market companies look to gain competitive advantage through implementation of sustainability practices . Walker et al. (2008) describes that high level of competition results in firms looking for competitive advantage and consider sustainability as a potential tool for gaining competitive advantage (Zhang et al., 2016). Furthermore, in a competitive market, some firms opt for cost-oriented operational strategy and adopt sustainable operations as a tool for cost-cutting (Walker et al., 2008). Thus it can be established that sustainability oriented competitive strategy influences a firm's implementation of sustainable practices.

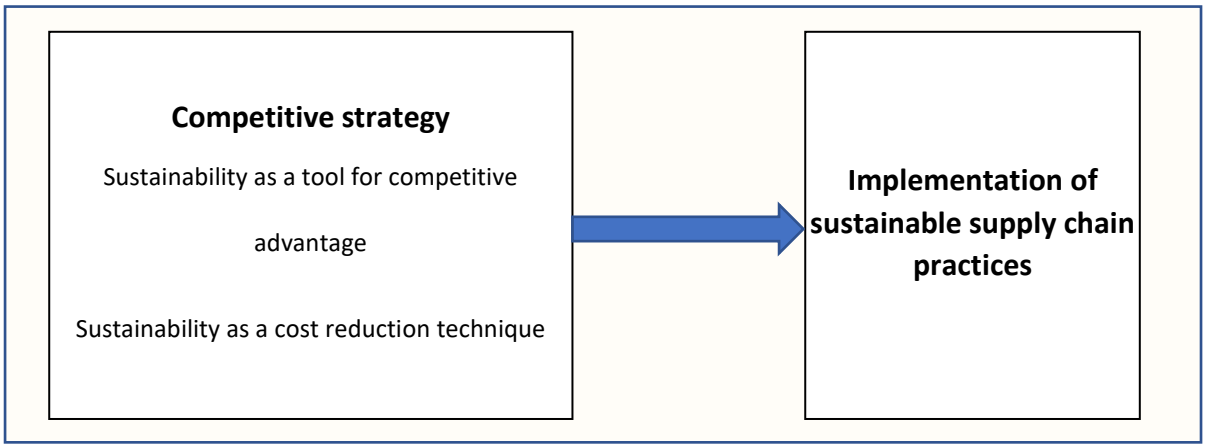

Figure 2.4 Conceptual model of competitive strategy

2.3.3 Stakeholders factors

Stakeholders role is considered crucial in most of the literature on SSCM. The literature by Matos & Silvestre (2013) talks about the importance of managing stakeholders relationship when developing sustainable business models. It further classifies stakeholders into primary and secondary stakeholders. Primary stakeholders are directly involved with supply chain operations such as suppliers, customers, distributors and consumers whereas secondary stakeholders include, the government, institutional agencies, NGO 's, media and the general public which are indirectly associated with supply chain activities. Seuring & Müller (2008) suggests that the pressure and incentives imparted by primary and secondary stakeholders are the critical factors for the initiation of sustainability efforts.

Primary stakeholders related factors such as consumer pressure on focal companies to adopt sustainability (Stefan Seuring & Müller, 2008; Walker et al., 2008), customer pressure obligating supplier company to adoption sustainability (Mani & Gunasekaran, 2018; Walker et al., 2008), Supplier cooperation (or poor supplier commitment) (Agyemang et al., 2018; Alzawawi, 2013), customer support through collaboration with suppliers (Trowbridge, 2001) has been identified in the respective literature. Furthermore, Walker et al., (2008) suggest that the supplier base of a company is also an important factor as firms with a limited supplier base are unwilling to pressurize and replace suppliers who do not meet the sustainability requirement.

Secondary stakeholder related factors are the most mentioned factors in the literature. Morais & Silvestre (2018) mentions secondary stakeholder pressure as extrinsic motivation that drives companies to undertake sustainability efforts in their supply chain. Secondary stakeholder related factors include governmental support and incentives for sustainability adoption, strict regulations, stringent administration by authorities and pressure from media, NGO's and society (Alzawawi, 2013; Lai-Ling Lam, 2011; Mani & Gunasekaran, 2018; Moktadir et al., 2018; Morais & Silvestre, 2018; B. S. Silvestre et al., 2018; Trowbridge, 2001; Walker et al., 2008). Furthermore, societal pressure is seen as a threat to a company's public reputation and drives them towards sustainable operations (Morais & Silvestre, 2018). Additionally, companies launch social initiatives in their supply chain to enhance their public reputation through marketing campaigns and look to gain competitive advantage (Morais & Silvestre,

2018). It is also noteworthy that secondary stakeholder factors stimulate top management commitment to sustainability (Moktadir et al., 2018). This is further validated in the literature (Agyemang et al., 2018; Yeo Soo Wee, 2006) where a lack of top management commitment is identified as a major barrier to sustainability adoption.

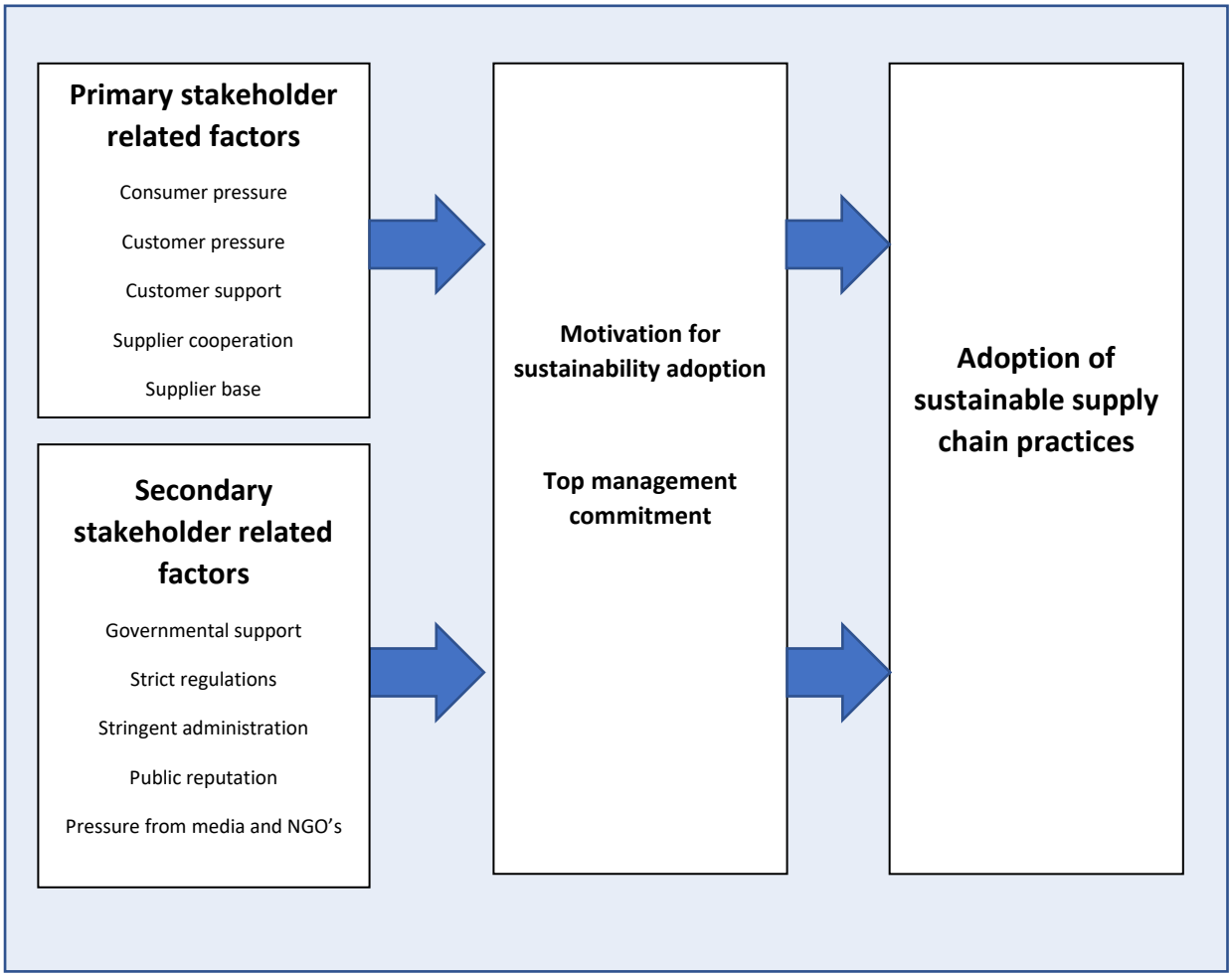

Figure 2.5 Conceptual model for stakeholder factors

2.3.4 Organizational readiness factors

Organizational readiness resembles the proactiveness of companies towards sustainability and influences firms adoption of sustainable supply chain practices. It can be measured by a range of indicators such as the availability of resources (human, technical and financial), Manager environmental awareness and supply chain capabilities (Lee, 2008). Management environmental awareness can be generated by the efficient information management system

to collect and maintain environmental information (Agyemang et al., 2018; Mangla et al., 2018) and environmental audits to monitor the environmental performance of the company (Yeo Soo Wee, 2006). On the other hand, importance of resources (Human, technical and financial) in successful implementation of sustainability practices is further justified as some studies mentioned lack of cleaner technology (Moktadir et al., 2018), skillful purchasing personnel (Bowen et al., 2001; Walker et al., 2008) and high cost of sustainability implementation (Alzawawi, 2013; Walker et al., 2008) as major barriers.

Supply chain capability resembles a firm's ability to foresee supply chain related risks and take a strategic proactive approach in SCM activities (Bowen et al., 2001). Supply chain capability includes cross-functional collaboration, supplier management (Bowen et al., 2001; Yeo Soo Wee, 2006) and risk management activities (Trowbridge, 2001). Cross-functional collaboration involves cross-functional communication of sustainability issues and involvement while designing supply chain strategies thereby enhancing organizational support (Lee, 2008). Supplier management aids in the strategic selection of suppliers and supplier collaboration to achieve sustainability goals. It involves factors such as the use of environmental performance as a criterion for suppliers selection, communication of environmental requirements of the company to the suppliers and involving crucial suppliers during the product development phase (Yeo Soo Wee, 2006). Risk management, on the other hand, monitors product sustainability-related risks and influence the inclusion of sustainability priorities (Trowbridge, 2001).

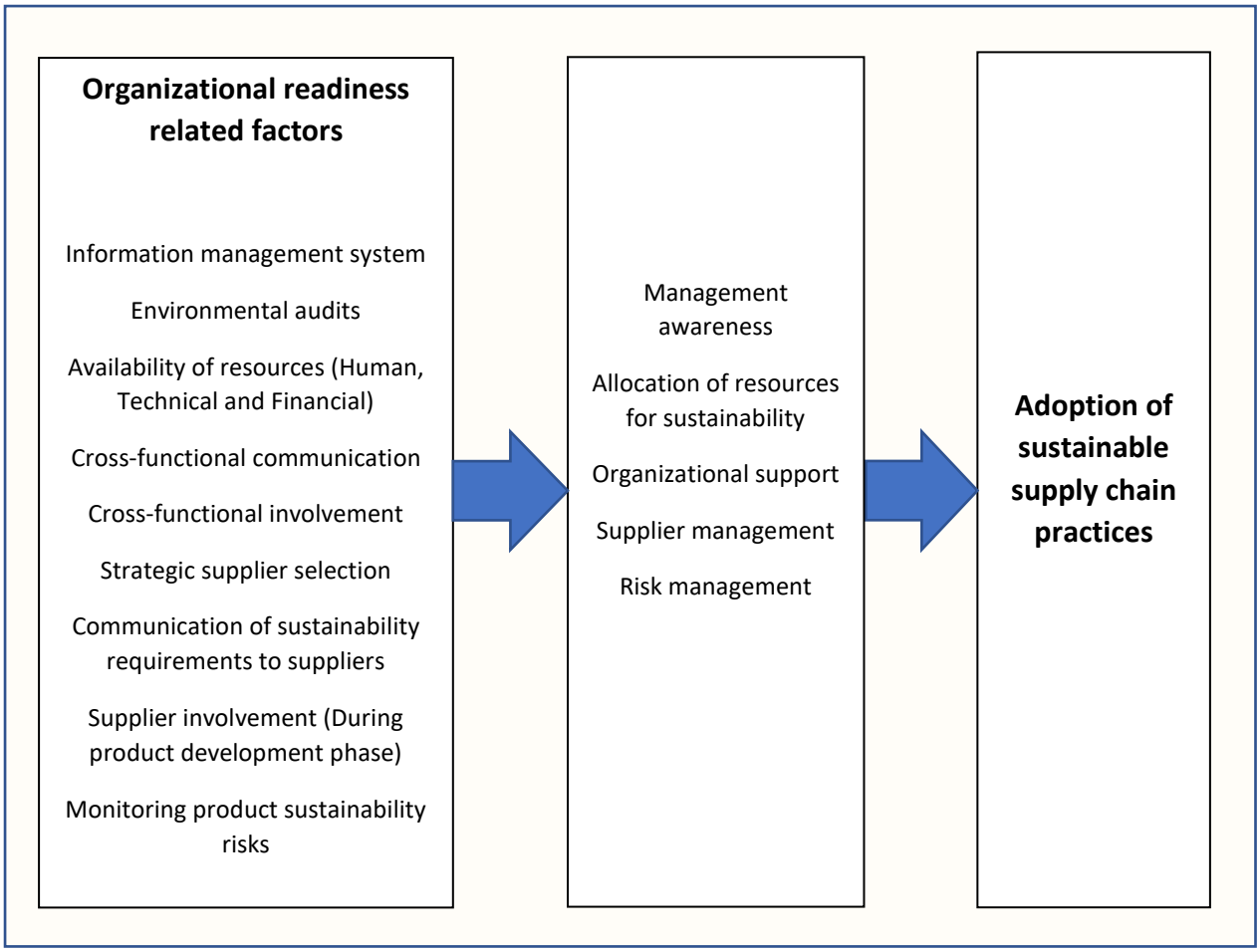

Figure 2.6 Conceptual model of organizational readiness factors

2.3.5 Sustainability policies and objectives

A number of studies highlight the importance of sustainability policies and objectives in the successful implementation of sustainable supply chain practices. Rao (2002) suggest that companies achieve GSCM goals through targets set by top management or through policies imposed by companies. Green, Morton, & New (1996) describes the importance of environmental policies towards environmental management. Walker, Di Sisto, & McBain (2008) conducted a research study on drivers of GSCM and describes, how different companies achieve their environmental sustainability goals through internal policies. Furthermore, Luthra & Mangla (2018) conducted a research study to explore the strategies for successful implementation of SSCM and concluded 'establishment of vision and objectives for supply chain sustainability as one of the important strategies. Drawing from these studies,

it can be established that sustainability policies and objectives are directly associated with the implementation of SSCM practices by companies.

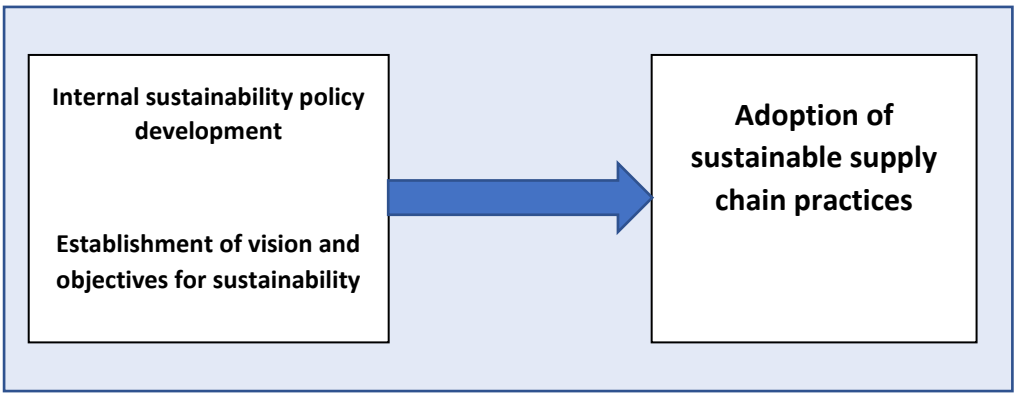

Figure 2.7 Conceptual model of Sustainability policies and objectives

2.4 Research model

The literature review has resulted in the identification of 8 management practices that are positively associated with sustainable supply chain management. These 8 management practices will be used as measurement items for measuring the 'Implementation of sustainable supply chain practices'. Furthermore, various factors gathered from existing studies that influence the implementation of sustainability practices will be used as predictor variables. As this is a cross-sectional study and doesn't involve manipulation of any variables, the notion of Dependent- Independent variables does not make sense, instead, the notion of the Predictor-Outcome variable to be used (Field, 2009). A conceptual model is developed Figure 2.8 which displays literature review outcomes and proposed research model to achieve research objective.

General hypothesis

Since the factors considered are derived from studies conducted in multiple industry/country context, a general hypothesis is set up. Additionally, some of the factors are derived from qualitative research studies and limit the establishment of the concrete hypothesis. A general hypothesis is that Training & education, Competitive strategy, Stakeholder factors, Organizational readiness, and Sustainability policies and objectives are associated with the implementation of sustainable supply chain practices considered in this study.

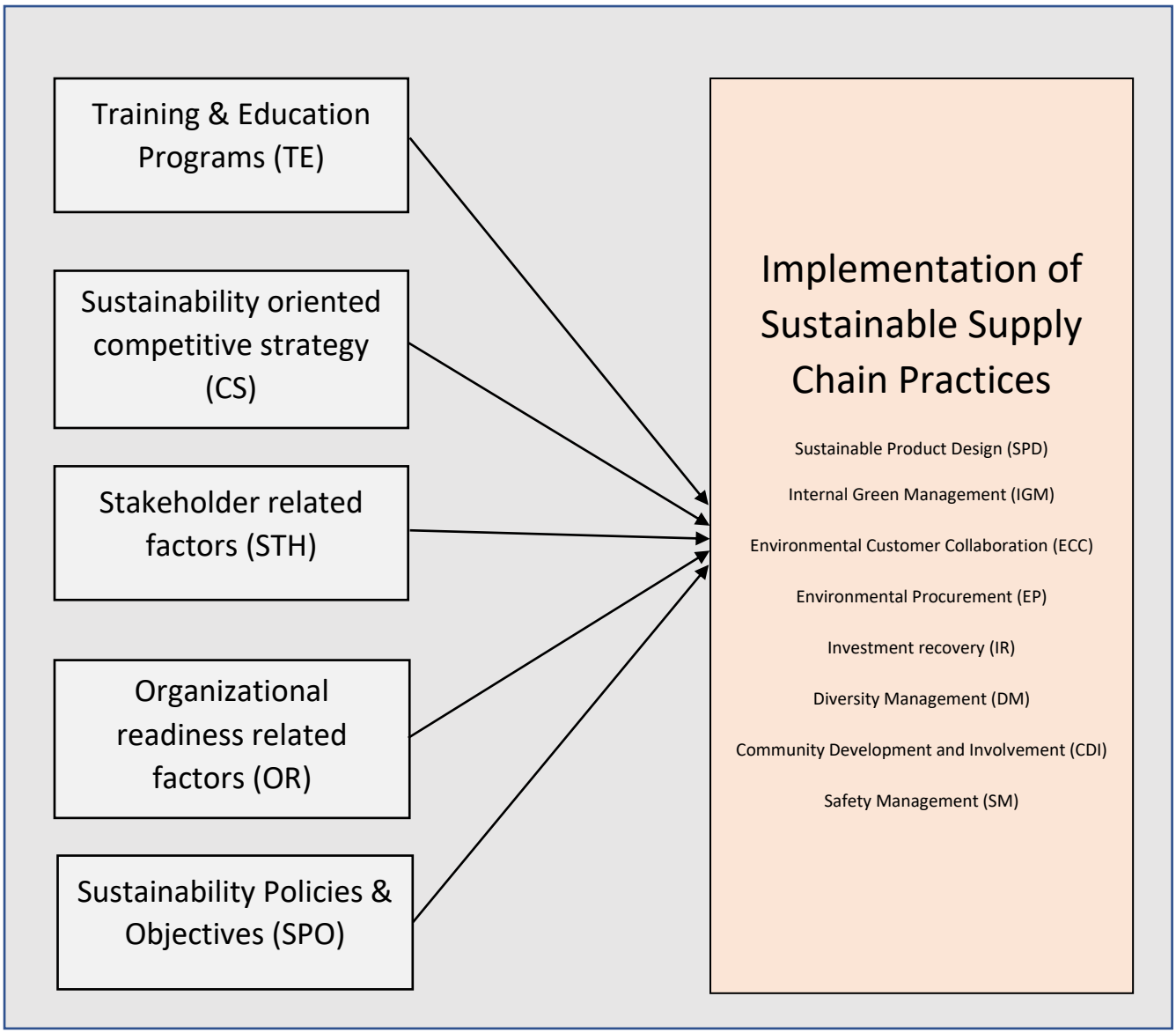

Figure 2.8 Research model

Chapter 3. Research design

3.1 Details of the study

This is an exploratory and descriptive type of study which aims to explore the factors that influence the implementation of sustainable supply chain practices in a context. According to Sekaran & Bougie (2013), the goal of the descriptive study is to describe relevant aspects of a phenomenon of interest from an individual, organizational or industry oriented perspective. Furthermore, this study employs a correlational type of investigation, where the correlation between factors and the implementation of sustainable supply chain practices will be studied.

The extent of researcher interference in the study is minimal and is conducted in a non-contrived setting. Unit of analysis is all type of product manufacturing companies in the BENELUX region. This study focuses on product manufacturing companies as the sustainable supply chain practices considered in this study are relevant to such an industry. This study is not limited to any specific product manufacturing companies as it aims to understand the phenomenon of sustainability implementation in a fundamental sense.

The initial focus was on Dutch manufacturing companies as most of the factors are region dependent (ex: culture, societal pressure and administration etc.). Due to the practical difficulties of achieving sufficient sample size, research scope was expanded to the BENELUX region. Furthermore, the BENELUX region is assumed to have relatively low cultural differences due to their geographical proximity. Finally, it is a cross-sectional type of study where data is gathered at once over a period of two months.

3.2 Measurement

This research employed a survey type of research tool to empirically investigate the relationship between factors (TE, CS, STH, OR and SPO) and the implementation of sustainable supply chain practices. The factors influencing the sustainability implementation are gathered from studies conducted in multiple industry/country contexts and are grouped into 5 main categories as mentioned earlier. A questionnaire is developed based on sustainable supply

chain practices (8 practices) and factors of sustainability implementation (5 categories). A survey question targeted at measuring the implementation of sustainable practices has 9 items under it, 8 corresponding to each of the sustainability practices (refer literature survey) and 1 for denoting 'None'. A dichotomous scale was used to measure each item under this question and a nominal scale was used to elicit the response (yes/no). 'Yes' for an item means that practice is implemented and 'No' means not implemented. The response type is 'multiple choice' and response value for each item is either 1 or 0. This enables the identification of specific sustainable practices implemented by an organization. Also, the measure of 'Level of implementation' on a scale of 0-8 can be derived from the response.

The factors of sustainability implementation consist of 27 measurement items sorted under 16 questions overall. Factors Training & education, Competitive strategy, and Sustainability policy & objectives had two measurement items under it whereas Stakeholder and Organizational readiness had 10 and 11 items respectively. A 5 points Likert scale (ranging from 'Very Low' to 'Very High') was used to measure all 27 measurement items. The response type is 'single choice'. All the questions (27+1) relevant to research were mandatory. This eliminated the problem of incomplete data.

Apart from research-related questions, an additional section consisting of questions (non-mandatory) related to the company and the respondent's profile was included in the last part of the questionnaire.

The complete questionnaire was shared with a supervisory committee consisting of people familiar with research subject for ensuring the Content validity of the questionnaires. Some minor corrections were suggested and the questionnaire was adapted accordingly. The questionnaire used for the study can be found in the Appendix section of this report for further reference. Table 3.1 summarises the structure of the questionnaire

Construct	Measurement items	Scale	Response range
Implementation of SSCM practices	SPD IGM EP ECC IR DM SM CDI	Dichotomous	Yes (1) No (0)
Sustainability training & education	T & E programs for employees T & E programs for employees	5-point Likert	Very Low (1) Very High (5)
Sustainability oriented competitive strategy	Sustainability as a cost-reduction technique Sustainability as a tool for competitive advantage	5-point Likert	Very Low (1) Very High (5)
Influence of stakeholder factors	Customer pressure Customer support Consumer pressure Supplier cooperation Supplier base Governmental support Strict regulations Stringent administration Public reputation Pressure from media & NGO's	5-point Likert	Very Low (1) Very High (5
Organizational readiness	Information management system Environmental audits to measure environmental performance Availability of human resource Availability of technical resource Availability of financial resource Cross-functional communication Cross-functional involvement Environmental selection of suppliers	5-point Likert	Very Low (1) Very High (5

	Communication of sustainability requirements to suppliers Monitoring product sustainability-related risks		
Sustainability policies and objectives	Internal sustainability policy development Establishment of vision and objectives for sustainability	5-point Likert	Very Low (1) Very High (5

Table 3.1 Structure of the questionnaire

Chapter 4. Data Collection

4.1 Survey tool

This research employed an online platform based survey tool called 'Collector' provided by TU Delft for data collection. This tool enables the researcher to formulate the survey questionnaire, create research panels, send out the invitation and follow up. Respondent's basic details along with email address have to be stored under a research panel and the researcher can send out the invitation to desired panels. Each respondent stored under a panel will receive an invitation email which consists of invitation message and a unique link to access the survey questionnaire. Alternatively, a general survey link can also be generated and shared in the case of anonymous respondents.

4.2 Target respondents

The target respondents of this study are senior personnel of product manufacturing companies. The reasoning behind targeting senior personnel is that they have a better understanding of the company's overall operation and have some level of influence over the company's decisions. A social media platform, LinkedIn was used to source the respondents. Survey respondents mainly consisted of senior manufacturing directors/managers, Senior supply chain managers/directors, Purchasing directors, sustainability directors/managers, Senior logistics managers/directors. These titles were used as keywords for searching people and a request message was sent only to personnel of product manufacturing companies. Location filter was applied to source the respondents, initially, The Netherlands followed by inclusion of Belgium and Luxemburg towards the end to increase the size of potential respondents. Keeping in mind the research contribution of the Technical University of Delft (Located in The Netherlands) to its surrounding society, the BENELUX region is chosen as a focus area.

4.3 Outcomes

A total of 340 relevant people were approached on social media 'LinkedIn' with a request message briefing about the thesis project, out of which around 200 people responded to the message. Among these 200, only 160 people agreed to complete the survey whereas other 40 expressed either their unavailability or lack of interest or no longer association with a product manufacturing company. Among those who agreed to take up the survey, 30 of them wanted to be an anonymous respondent and received a general link to the survey. The rest 130 people shared their email ID and received a unique survey link via 'Collector' tool. Series of reminders were sent to the respondents over a period of two months. Majority of respondents completed the survey in one or two sessions. A few of respondents quit the survey mid-way through and never returned creating a useless data in the system. In the end, a total of 112 complete responses were recorded out of which 16 are anonymous responses. The response rate is relatively low (33%) but just above the accepted response rate of 30% for the mail questionnaires (Sekaran, 2006). According to Field (2009), a general rule of thumb is to have 10-15 cases of data per predictor and if researcher expects to find a large effect then the sample size of 80 (up to 20 predictors) will always suffice. Based on this reference and assuming some of the predictors considered in this study are multi-dimensional, a sample size of 112 is still sufficient and justified. Table 4.1 shows the profile of the survey respondents and Table 4.2 displays characteristics of sample companies. The Netherlands forms a major share of sample companies (70%) followed by Belgium and Luxemburg.

It is observed that majority of the respondents held a high position in the company. This enables us to safely assume respondents were part of discussions leading to important decisions and/or they had some level of influence on a company's decisions concerning sustainability. Furthermore, the majority of them being associated with the present company for at least 4 years, adds credibility to the data as they might have observed the challenges associated with the implementation of sustainability practices in the company during last 4-15 years. Another observation derived from the characteristics of the sample is that the majority of the companies (Electricals & Electronics 20%, Consumer goods 27%, Food & Beverages 23%) are associated with the manufacturing of products used by consumers in day-to-day life. It can be suspected that these companies are concerned about their public image

and engage in environmental and social sustainability practices to enhance their public reputation.

Criteria	Total	Percentage
Job Title		
Junior engineer or equivalent	4	4%
Senior engineer or equivalent	10	9%
Assistant manager or equivalent	3	3%
Mid-level manager or equivalent	43	38%
Top level manager or equivalent	28	25%
Board of directors, decision maker or equivalent	10	9%
Non-response/Missing	14	13%
Total	**112**	**100%**
Experience (In present organization)		
0-3 Years	33	29%
4-6 Years	18	16%
7-10 Years	15	13%
11-15 Years	12	11%
16-20 Years	12	11%
Above 20 Years	8	7%
Non-response/Missing	14	13%
Total	**112**	**100%**
Experience (In manufacturing industry)		
0-3 Years	13	12%
4-6 Years	10	9%
7-10 Years	11	10%
11-15 Years	16	14%
16-20 Years	19	17%
Above 20 Years	29	26%
Non-response/Missing	14	13%
Total	**112**	**100%**

Table 4.1 Respondent's Profile

Criteria	Total	Percentage
Product manufacturing industry		
Electricals & Electronics	22	20%
Metal Manufacturing	10	9%
Medical Devices & Equipments	5	4%
Machinary Manufacturer	9	8%
Consumer Goods	30	27%
Food & Beverages Manufacturing	26	23%
Chemicals	4	4%
Plastic products	5	4%
Packaging Materials	5	4%
Automotive	4	4%
Non-response/Missing	8	7%
Total	**128**	**114%**
Note: Total percentage is above 100 as some companies operate in multiple industries		
Number of employees		
1 to 9	2	2%
10 to 49	6	5%
50 to 99	6	5%
100 to 249	11	10%
250 to 499	14	13%
500 and above	65	58%
Non-response/Missing	8	7%
Total	**112**	**100%**
Average turnover (Last 2-3 years) in $		
Less than 10M $	2	2%
Between 10M$-20M$	6	5%
Between 20M$-30M$	4	4%
Between 30M$-40M$	12	11%
Between 40M$-50M$	5	4%
Above 50M$	75	67%
Non-response/Missing	8	7%
Total	**112**	**100%**
Country		
The Netherlands	78	70%
Belgium	12	11%
Luxemburg	6	5%
Anonymous	16	14%
Total	**112**	**100%**

Table 4.2 Characteristics of Sample

Chapter 5. Data analysis

5.1 Data Preparation

Before proceeding to data analysis the intermediate step was to prepare a final set of variables and measure the reliability of items measuring respective variables. Two approaches were followed; Principle Component Analysis and Reliability analysis.

5.1.1 Principle Component Analysis

Suspecting the multi-dimensionality of some of the main factors, an exploratory factor analysis (PCA) was conducted on Stakeholder factors (10 items) and Organizational readiness (11 items) to reduce the data and derive meaningful factors. The method used is Principle Component Analysis (PCA) followed by a Varimax rotation. Three criteria were adopted in PCA based on relevant literature. 1) The extraction method for factors was based on 'eigenvalues greater than 1' as per the recommendation of (Hair et al., 2010). 2) Factor loadings above 0.512 were considered significant for sample size around 100 (Field, 2009) 3) The variance of extracted measurement items should be greater than the value of 0.5 (Field, 2009).

5.1.2 PCA of Stakeholder factors

A principal component analysis (PCA) was conducted on 10 items with orthogonal rotation (Varimax). The Kaiser-Meyer-Olkin measure verified sampling adequacy for the analysis, KMO=0.725 which is greater than the recommended value of 0.6 (Worthington & Whittaker, 2006). Bartlett's test of sphericity $X^2(45)= 438.71$, $p< 0.001$, indicating that correlations between items were sufficiently large for PCA (Field, 2009). The analysis resulted in 4 components each with an eigenvalue greater than one and cumulative explained variance of 77.18%. Based on kaiser's criterion and convergence of scree plot all 4 components were retained for final analysis. Table 5.1 shows factor loadings after rotation. Communality of all items extracted was well above 0.5 and all factor loadings above 0.718. No significant cross-loading was observed. The items that cluster on the same components suggest that

component 1 represents Government and institutional factors (GIF), component 2 a Downstream supply chain factors (DSCF), component 3 Upstream supply chain factors (USCF), and component 4 Corporate social image (CSI).

Rotated Component Matrix				
Variables	Component			
	GIF	DSCF	USCF	CSI
Stringent Administration of agencies	0.873			
Strict Regulations	0.845			
Governmental Support	0.788			
Customer Pressure		0.869		
Customer Support		0.745		
Consumer Pressure		0.718		
Supplier Base			0.886	
Supplier Cooperation			0.862	
Pressure from media & NGO's				0.902
Public Reputation				0.852
Extraction Method: Principal Component Analysis				

Table 5.1: A rotated component matrix of stakeholder factors

5.1.3 PCA of Organizational readiness

A principal component analysis (PCA) was conducted on 11 items with orthogonal rotation (Varimax). The Kaiser-Meyer-Olkin measure verified sampling adequacy for the analysis, KMO=0.777 which is greater than the recommended value of 0.6 (Worthington & Whittaker, 2006). Bartlett's test of sphericity $X^2(55)= 624.031$, $p< 0.001$, indicating that correlations between items were sufficiently large for PCA (Field, 2009). The analysis resulted in 3 components each with an eigenvalue greater than one and cumulative explained variance of 70.102%. Based on kaiser's criterion and convergence of scree plot all 3 components were retained for final analysis. Table 5.2 shows the rotated component matrix. Communality of one of the item 'Supplier involvement' was below 0.5 and hence it was eliminated. Communality of rest of the items extracted was above 0.566 and all factor loadings above 0.635. No significant cross-loading was observed. The items that cluster on the same components suggest that component 1 represents Information and supplier management

(ISM), component 2 a Cross-functional collaboration and risk management (CRM), and component 3 Availability of resources (AR).

Rotated Component Matrix			
Variables	Component		
	ISM	CRM	AR
Environmental performance of the supplier as a criterion for supplier selection	0.870		
Communication of environmental sustainability requirements to suppliers	0.848		
Environmental audits	0.718		
Information management system	0.673		
Cross-functional involvement		0.884	
Cross-functional communication		0.747	
Monitor product sustainability risks		0.635	
Supplier involvement		0.542	
Availability of Human Resource			0.870
Availability of Financial Resource			0.850
Availability of Technical Resource			0.840
Extraction Method: Principal Component Analysis.			

Table 5.2 A rotated component matrix of organizational readiness factors

5.1.4 Reliability analysis

Reliability analysis was conducted on all 10 factors (3 original factors and 7 resulting from PCA) to ensure the internal consistency of measurement items under it. The resulting Cronbach's alpha values for all the factors were well above the threshold of 0.7 (Field, 2009). Furthermore, a reliability analysis was also performed on 8 measurement items of a dichotomous scale. The resulting Kuder-Richardson reliability coefficient (the alternative of Cronbach's alpha and suitable for dichotomous scale) was 0.816 confirming inter consistency between items. The results of PCA and reliability analysis is captured in Table 5.3

Variable	Measurement items	Factor Loadings	Cronbach's alpha (α)
Training & Education (TE)	Sustainability-related training and education programs for employees Sustainability-related training and education programs for employees		0.863
Competitive Strategy (CS)	Sustainable practices as a cost-reduction technique Sustainable practices as a potential tool for competitive advantage		0.701
Government and Institutional Factors (GIF)	Stringent administration Strict regulations Governmental support	0.873 0.845 0.788	0.815
Upstream Supply Chain Factors (USCF)	Supplier base Supplier cooperation	0.886 0.862	0.815
Downstream Supply Chain Factors (DSCF)	Customer pressure Customer support Consumer pressure	0.869 0.745 0.718	0.753
Corporate Social Image (CSI)	Pressure from media & NGO's Public reputation	0.902 0.852	0.818
Information and Supplier Management (ISM)	Environmental selection of suppliers Communication of sustainability requirements to suppliers Environmental audits Information management system	0.867 0.848 0.718 0.673	0.859
Cross-functional collaboration and Risk Management (CRM)	Cross-functional involvement Cross-functional communication Monitoring product sustainability-related risks	0.884 0.747 0.635	0.800
Availability of Resources (AR)	Availability of human resource Availability of financial resource Availability of technical resource	0.870 0.845 0.836	0.818
Sustainability Policies and Objectives (SPO)	Internal sustainability policy development Establishment of vision and objectives for sustainability		0.922
Implementation of sustainable supply chain practices	SPD IGM EP ECC IR		0.816

	DM SM CDI		

Table 5.3 Results of PCA and Reliability analysis

5.1.5 Revised research model

After performing PCA and reliability analyses a final set of predictor variables were obtained. A research model used in the data analysis is shown in Figure 5.1 A revised research model. There are 10 predictor variables whose influence will be tested on the implementation of each of the practices. Additionally, the reliability analysis of 8 measurement items corresponding to 8 management practices resulted in reliability coefficient value of 0.816, confirming that all these items are measuring common variable and can be combined to have a single variable. Therefore, an additional outcome variable 'Level of Implementation' will be generated as described earlier in section 3.2, and its relationship with predictor variables will be tested.

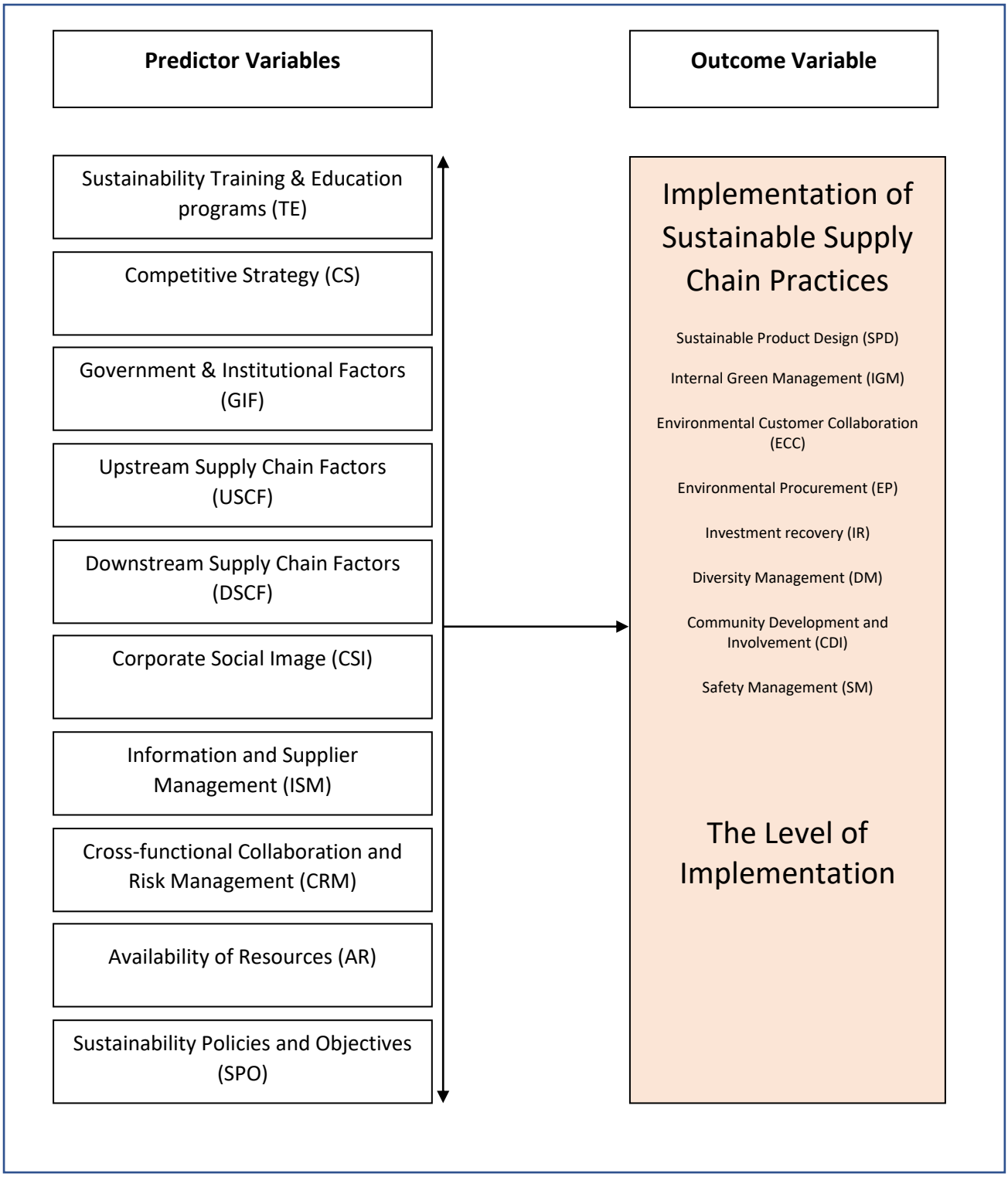

Figure 5.1 A revised research model

5.2 Data Analysis & Discussion of Results

This section presents the analysis of data collected through the survey and corresponding results. Data analysis is divided into four parts. Part one corresponds to descriptive and correlation statistics of all variables, part two deals with the analysis of the relationship between factors and implementation of SSCM practices (Binary Logistic Regression), part three presents an analysis of the relationship between factors and level of implementation (Multiple regression) and final section provides the comparison between two regression analysis and summary of results. The tool used for data analysis is SPSS V25 provided by the Delft University of Technology.

5.2.1 Descriptive and Correlation statistics

This section is dedicated to descriptive analysis and correlation analysis of all the variables. Analysis of Predictor variables is presented first followed by outcome variables.

5.2.1.1 Predictor variables

A descriptive and correlational analysis was conducted on all the items used in this study for measuring the variables. Table 5.4 presents the descriptive statistics of all 27 items used to measure 10 predictor variables. The survey respondents were asked to rate the effort towards and influence of various measurement items on a scale of 1 to 5. It is observed that generally, sample companies experience a moderate influence of most of the stakeholder factors. However, the influence of downstream supply chain stakeholders is above moderate. Coming to the organization readiness related factors, the influence of 'Availability of resources' is below moderate meaning that sample companies had sufficient resources to undertake sustainability initiatives. Companies exert above moderate effort towards Cross-functional collaboration & Risk management and Competitive strategy. This means that the majority of the companies believe in cross-functional collaboration and risk management activities for the successful implementation of practices. Also, many companies considered sustainability as a potential tool to reduce cost and as a tool to gain competitive advantage.

Looking at the descriptives of Training & Education, it is observed that many companies do not organize sustainability-related training and education programs. The reasons for this could be either these companies have already implemented most of the sustainability practices and may not require rigorous training & education programs or companies are unaware of the potential benefits of sustainability training & education programs. Finally, it is observed that effort towards SPO is above average which suggests that top management commitment is generally high and they strongly believe in policies and objectives to achieve sustainability goals.

Descriptive Statistics	Factor loading	Min	Max	Mean	Std. Dev
Training & Education (TE)					
Sustainability related training & education programs for employees		1	5	2.89	1.203
Sustainability-related training & education programs for suppliers		1	5	2.58	1.213
Competitive Strategy (CS)					
Sustainable practices as a potential tool for competitive advantage		1	5	3.46	1.098
Sustainable practices as a cost-reduction technique		1	5	3.21	1.041
Government & Institutional Factors (GIF)					
Governmental Support	0.788	1	5	2.95	0.966
Strict Regulations	0.845	1	5	3.49	1.013
Stringent Administration of agencies	0.873	1	5	3	0.959
Upstream Supply Chain Factors (USCF)					
Supplier Base	0.886	1	5	2.9	0.859
Supplier Cooperation	0.862	1	5	3.13	0.921
Downstream Supply Chain Factors (DSCF)					
Customer Pressure	0.869	1	5	3.61	0.971
Customer Support	0.745	1	5	3.26	0.928
Consumer Pressure	0.718	1	5	3.41	1.119
Corporate Social Image (CSI)					
Pressure from media & NGO's	0.902	1	5	3.02	1.17
Public Reputation	0.852	1	5	3.71	1.008
Information and Supplier Management (ISM)					
Information management system	0.673	1	5	3.38	1.148
Environmental audits	0.718	1	5	3.42	1.12
Environmental performance of the supplier as a criterion for supplier selection	0.867	1	5	3.15	0.997
Communication of environmental sustainability requirements to suppliers	0.848	1	5	3.29	0.955
Availability of Resources (AR)					
Availability of Human Resource	0.87	1	5	2.67	1.06
Availability of Technical Resource	0.836	1	5	2.79	1.041
Availability of Financial Resource	0.845	1	5	2.79	1.035
Cross-functional Collaboration and Risk Management (CRM)					
Cross-functional communication	0.747	1	5	3.39	1.051
Cross-functional involvement	0.884	1	5	3.22	1.063
Monitor product sustainability risks	0.635	1	5	3.57	1.02
Sustainability Policies and Objectives (SPO)					
Sustainability policy development		1	5	3.43	1.054
Establishment of vision and objectives for sustainability		1	5	3.63	1.065
Valid N (listwise) = 112					

Table 5.4 Results of descriptive statics of predictor variables

Next, a correlation analysis was conducted on 10 predictor variables to investigate any significant correlation. Table 5.5 shows the results of correlation analysis. It is interesting to see that factors CS, SPO, ISM, and CRM have a significant positive correlation with training & education, which suggests that training & education programs enhance firms knowledge of sustainability thereby making companies to adopt a proactive approach towards sustainability goals (Yeo Soo Wee, 2006). Additionally, TE is significantly correlated with USCF which is in line with the theory as Mangla et al. (2018) recommended training and education programs to suppliers for behavioral change.

Correlations	TE	CS	SPO	GIF	DSCF	USCF	CSI	ISM	CRM	AR
TE	1									
CS	.612**	1								
SPO	.621**	.546**	1							
GIF	0.027	0.107	0.076	1						
DSCF	0.057	0.17	0.074	.313**	1					
USCF	.397**	.343**	.383**	.262**	.407**	1				
CSI	.214*	.281**	.327**	.282**	.399**	.332**	1			
ISM	.633**	.463**	.712**	.225*	0.185	.419**	.300**	1		
CRM	.646**	.592**	.746**	0.126	0.037	.383**	.228*	.596**	1	
AR	-0.147	-0.047	-0.152	0.165	0.068	0.084	0.064	-.199*	0.009	1
** Correlation is significant at the 0.01 level (2-tailed)										
* Correlation is significant at the 0.05 level (2-tailed)										

Table 5.5 Results of correlation analysis of predictor variables

Competitive Strategy (CS) is significantly correlated with Sustainable Policies and Objectives (SPO), Cross-functional collaboration and risk management (CRM), and Information and supplier management (ISM) which is self-explanatory. Companies with sustainability-oriented competitive strategy focus on these aspects to better adopt sustainable practices. A high correlation of SPO with CRM and ISM mean that companies with strong sustainability policies and objectives take a strategic approach and show high efforts of CRM and ISM. Additionally, a significant correlation between CRM and SPO is in line with the theory where it is stated that cross-functional collaboration leads to organizational support thereby driving companies towards sustainability objectives (Lee, 2008). A significant correlation between GIF and DSCF is again self-explanatory which means that when institutional pressure increases, the customer companies start exerting more pressure on and provide support to the sample companies.

A significant correlation between GIF and USCF could mean that with the rising influence of GIF, sample companies face pressure to adopt sustainability whereas it is hesitant to replace its non-performing supplier or exert pressure. Because replacing the suppliers leads to a high influence of supplier base whereas exerting pressure may lead to supplier non-cooperation. The same goes for the correlation of USCF with DSCF and SPO. A final interesting observation is a significant negative correlation between ISM and AR, which indicates that as the influence of AR increases (low resources), companies' efforts towards Information and supplier management reduces.

5.2.1.2 Outcome variables

A descriptive analysis was performed on 8 of the management practices and Table 5.6 shows the results of it. Safety management (SM) is the highest adopted practice among sample companies. More than half of the companies have implemented practices SPD, IGM, EP, SM, and CDI. These practices relate to Internal Green Supply Chain Management and Corporate Social Responsibility in the theoretical framework. ECC refers to collaborating with customer companies to achieve sustainability goals and it may not be completely relevant to 50% of the sample companies (Food & Beverages 23% and Consumer Goods 27%) as they operate in B2C (Business to consumer) market. This explains 46% yes for ECC. Overall, the adoption of sustainable practices is stable over the sample except for IR and DM which shows below average implementation.

Practices	SPD	IGM	EP	ECC	IR	DM	SM	CDI
Yes	60	62	61	52	40	38	86	61
No	52	50	51	60	72	74	26	51
Yes %	54%	55%	54%	46%	36%	34%	77%	54%
No %	46%	45%	46%	54%	64%	66%	23%	46%
Mean	0.54	0.55	0.54	0.46	0.36	0.34	0.77	0.54
Min	0	0	0	0	0	0	0	0
Max	1	1	1	1	1	1	1	1
N=112 Yes= Implemented No= Not implemented								

Table 5.6 Frequency table of sustainable supply chain practices

The level of implementation of SSCM practices was calculated based on the summation of the number of practices implemented by a sample company. A descriptive analysis was done for the level of implementation. Table 5.7 and Figure 5.2 shows the characteristics of it. It is observed that on an average, companies have implemented 4 out of 8 practices and 67 (59.8%) of sample companies have implemented at least 4 practices.

Level of Implementation	Frequency	Percentage
None of the practices	10	9%
One practice	14	13%
Two practices	14	13%
Three practices	7	6%
Four practices	14	13%
Five practices	16	14%
Six practices	13	12%
Seven practices	9	8%
Eight practices	15	13%
Total	112	100%
Mean	4.11	
Mode	5	
Min	0	
Max	8	

Table 5.7 Descriptive of the level of implementation

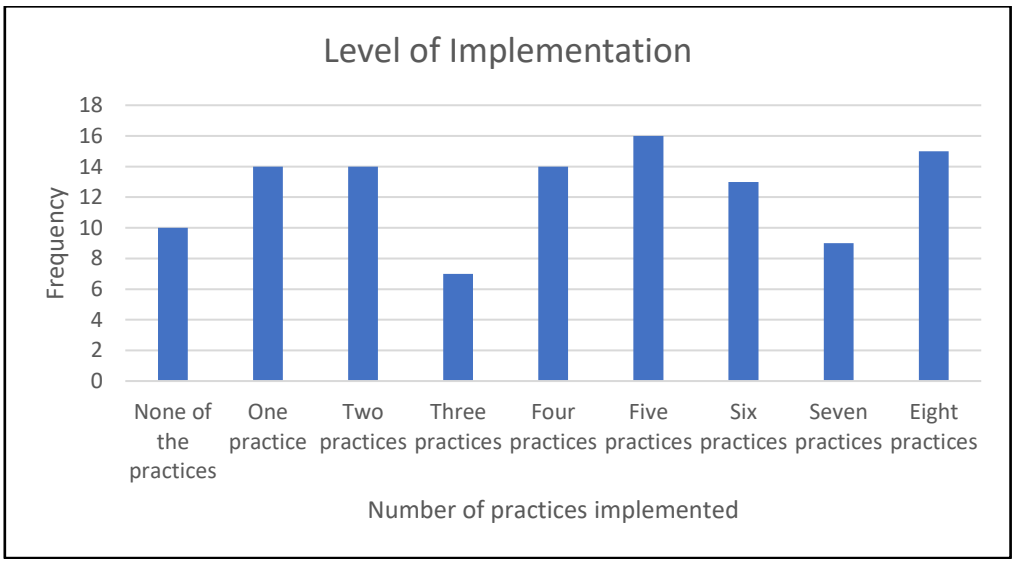

Figure 5.2 The level of implementation

Next, a correlation analysis was done to explore the relationship between the implementation of each of the practices. The results are presented in Table 5.8. It is observed that there is a significant correlation between IGSCM practices (SPD and IGM) and EGSCM practices (EP, ECC, and IR). This result aligns with the theory (K. W. Green et al., 2013; Qinghua Zhu et al., 2007) and confirms our hypothesis P which states, There is a significant correlation between implementation of IGSCM practices and implementation of EGSCM practices.

Correlations	SPD	IGM	EP	ECC	IR	DM	SM	CDI
SPD	1							
IGM	.388**	1						
EP	.335**	.441**	1					
ECC	.364**	.548**	.528**	1				
IR	.208*	.257**	.270**	.390**	1			
DM	.213*	.416**	.277**	.429**	0.174	1		
SM	.251**	.314**	.304**	.385**	.366**	0.171	1	
CDI	.371**	.549**	.352**	.528**	.270**	.390**	.516**	1
** Correlation is significant at the 0.01 level (2-tailed).								
* Correlation is significant at the 0.05 level (2-tailed).								

Table 5.8 Correlation analysis of SSCM practices

To double check, the applicability of hypothesis a phi-coefficient and Cramer's V test (suitable for analyzing the correlation between binary variables) was conducted to explore the relationship between implementation of IGSCM and EGSCM practices which further validates hypothesis **P** and alignment with the theory. The results are tabulated in Table 5.9.

Cross Tab N=112		EP			R	Sig.		ECC			R	Sig.		IR			R	Sig.	
		No	Yes	Total	Value	Phi	Cramer's V	No	Yes	Total	Value	Phi	Cramer's V	No	Yes	Total	Value	Phi	Cramer's V
SPD	No	33	19	52				38	14	52				39	13	52			
	Yes	18	42	60	0.335	0.000	0.000	22	38	60	0.364	0.000	0.000	33	27	60	0.208	0.028	0.028
	Total	51	61	112				60	52	112				72	40	112			
IGM	No	35	15	50				42	8	50				39	11	50			
	Yes	16	46	62	0.441	0.000	0.000	18	44	62	0.548	0.000	0.000	33	29	62	0.257	0.007	0.007
	Total	51	61	112				60	52	112				72	40	112			

Table 5.9 Phi and Cramer's V test of SSCM practices

5.2.2 The relationship between factors and the implementation of SSCM practices

A binary logistic regression analysis was conducted to explore the predictor variables that impact the implementation of SSCM practices in organizations. This method is suitable because the outcome variable is a binary variable with 1 representing the implementation of practice and 0 representing a non-implementation. Therefore, the resulting coefficients will reflect the impact of predictor variables on the likelihood of an SSCM practice being implemented (Hair et al., 2010). Furthermore, the main advantage of logistic regression compared to multiple regression is lack of assumption requirements. Logistics regression does not require a linear relationship between outcome and predictor variables do not require any specific distribution and issues such as heteroscedasticity do not pose any problems (Hair et al., 2010).

5.2.2.1 Estimation of the logistics regression model and the interpretation of results

Logistic regression has one outcome variable composed of estimated coefficients corresponding to each predictor variable. Here the outcome variable is estimated bit differently than a regular regression model. It employs an S-shaped logistic curve of predicted values and tries to fit this curve with observed data similar to the regression line. Figure 5.3 shows the S-shaped logistic curve used in logistic regression to explore the relationship between outcome and predictor variables. Since the outcome variables here lies between 0 and 1 to keep the estimated values within the range of 0 to 1, it employs a logit transformation of the outcome variable to account for each level of the predictor (1-5) variable in the logistic regression model. It does it in two steps, first, the probabilities are converted into odds and then logit value is calculated by taking the logarithm of odds.

The estimated coefficients in logistic regression are estimated either using logit value or odds value. Hence the interpretation of coefficients is slightly different to the regression model. The coefficients resulting from logistic regression analysis, the original B values resemble logit of odds (Logarithm of odds). However, SPSS program provides exponentiated logistic coefficients **EXP B** (antilog of B) which reflects the odds ratio of the outcome variable being 1 (practice implemented in our case). The direction of the relationship between outcome and

predictor variable can be assessed using both types of coefficients. Positive values of B resemble a positive relationship and vice versa. As EXP B values can never be negative, values less than 1 resembles a negative relationship and vice versa.

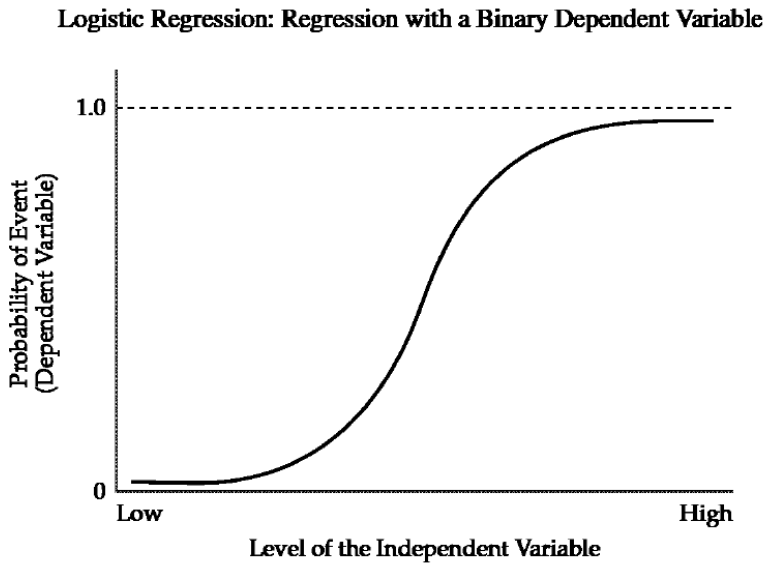

Figure 5.3 Form of the logistic relationship between outcome and predictor variables (Hair et al., 2010)

The magnitude of the relationship is better interpreted with EXP B values. An EXP B value of 2 means that 1 unit increase in the predictor variable increases the odds of outcome variable being true by 2. Calculation of percentage change in odds and probabilities are presented below. Table 5.10 summarizes interpretation of results of a binary logistic regression. All the above description of model estimates and interpretation of results are derived from (Hair et al., 2010)

Percentage change in odds = (EXP B - 1) *100

Probabilities = Odds/(Odds+1)

Parameter	Measure	Description
B	Logit (Log of Odds)	'+' = Positive relationship between predictor and outcome variable '-' = Negative relationship between predictor and outcome variable
EXP B (Explonentiated B)	Odds	Magnitude of relationship. Amount increase/decrease in odds of dichotomous outcome variable being true (1) when continuous predictor variable increases by 1 unit
Cox & Snell R^2 Nagelkerke R^2	Measure of overall model fit	Percentage of variation in outcome variable explained by the logistic model
Model X^2(dF)	Chi-Square based measure of overall predictive accuracy	Predictive accuracy of the model dF= Degrees of freedom

Table 5.10 Interpretation of results of Binary logistic regression

5.2.2.2 Binary Logistic Regression

A series of 8 binary logistics were performed to explore the relationship between factors and implementation of each of 8 SSCM practices. The method of variable selection used in the regression is 'Enter' as many of the authors recommend this method (Field, 2009; Hair et al., 2010) and due to chances of committing Type 1 error while using automated variable selection methods provided by computer programs (Austin & Tu, 2004). Table 5.11 presents the results of all the 8 binary logistic regressions. The outcome variable is coded as 1=Implementation and 0=Non- implementation. Therefore, the value of 'Exp B' describes the odds of a practice being implemented when a significant influencing factor increases by 1 unit.

The Chi-Square measure for all the model is highly significant confirming the predictive accuracy of the measurement. Also, measures of R^2 shows various degrees of model fit for each practice. The values of R^2 for IR, DM, and SM are relatively lower and can be attributed to the disproportion of implementation and non-implementation categories as seen in section (5.2.1.2). The model for IR explains only 16.62% of the variation and it is attributed to the reduced implementation of this practice by sample companies. Finally, the multicollinearity is not an issue as VIF of all the predictors are below 3.5 (well within the value of 10) and Tolerance level is above 0.3. The VIF of all the predictors is presented in the section (5.2.3) along with multiple regression results.

Factors/Practices	SPD		IGM		EP		ECC		IR		DM		SM		CDI	
	B	EXP B	B	EXP B	B	EXP B	B	EXP B	B	EXP B	B	EXP B	B	EXP B	B	EXP B
TE	0.15	1.16	0.51	1.67	-0.02	0.98	0.37	1.44	-0.89	0.92	0.47	1.61	0.56	1.75	0.76*	2.13
CS	0.85*	2.34	0.8*	2.20	0.40	1.50	0.40	1.50	0.64^{+}	1.89	-0.52	0.60	-0.4	0.67	-0.01	0.91
SPO	1.35*	3.87	1.84**	6.30	2.03***	7.56	1.26**	3.52	0.69^{+}	1.98	0.75^{+}	2.13	0.69	1.20	0.86^{+}	2.37
GIF	0.04	1.04	0.34*	1.40	0.23	1.26	0.18	1.12	0.07	1.07	0.16	1.17	0.12	1.12	0.05	1.05
DSCF	-0.04	0.96	0.03	1.03	-0.26	0.77	0.21	1.23	-0.15	0.86	-0.05	0.96	0.13	1.14	0.06	1.06
USCF	-0.59*	0.55	-0.72**	0.49	0.08	1.09	-0.28	0.76	0.08	1.08	0.09	1.10	-0.72*	0.49	-0.50*	0.61
CSI	0.22	1.25	0.18	1.19	-0.12	0.88	-0.02	0.99	0.05	1.05	0.29^{+}	1.34	0.30	1.35	0.57**	1.77
ISM	0.31*	1.36	0.04	1.04	0.10	1.11	0.20	1.21	0.11	1.12	0.04	1.04	0.25	1.28	0.11	1.12
CRM	-0.54*	0.58	-0.65*	0.52	-0.24	0.79	-0.26	0.77	-0.36^{+}	0.70	-0.12	0.89	0.01	1.01	-0.14	0.87
AR	-0.25*	0.78	0.12	1.12	-0.02	0.98	0.17	1.18	0.03	1.03	0.03	1.03	0.20	1.22	0.23	1.26
Cox & Snell R^2	0.39		0.37		0.40		0.33		0.14		0.22		0.25		0.48	
Nagelkerke R^2	0.51		0.50		0.54		0.45		0.19		0.30		0.37		0.36	
Model $X^2(10)$	54.39***		52.21***		57.32***		45.34***		16.62^{+}		27.05**		31.82***		50.11***	
*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, $^{+}P < 0.10$																

Table 5.11 Results of logistic regression analysis

5.2.2.3 Discussion of results

A significant association of Training and education with CDI is in line with the theory. Training & education in this study contexts include both employees and suppliers. Haugh & Talwar (2010) highlights that employees are unaware of sustainability issues beyond their immediate work environment and through employee training and education programs, large companies drive the employees towards addressing social issues. Training and education programs to the suppliers align with social contract theory. According to social contract theory, there are two types of social contracts between members of society and the society, macro and micro social contracts. The micro-social contract refers to specific forms of social involvement (Gray, Owen, & Adams, 1996; Zhang et al., 2016) and through training, support and other activities companies enhance their social involvement (Gimenez & Tachizawa, 2012). Morais & Silvestre (2018) also highlights the involvement of companies with society in the form of Training and Education.

Sustainability-related training and education programs do not have a significant influence on the implementation of most of the other practices considered. One of the reason could be that the reference studies which implicate the influence of T&E on GSCM practices are

conducted in a developing and economically challenged country context (Mangla et al., 2018; Moktadir et al., 2018) where lack of awareness of sustainable practices is a major issue. As this study is conducted in a developed country context where knowledge and awareness of sustainability are expected to be high and companies do not organize training and education programs rigorously as observed from the descriptive analysis. Another reason could be that some of the sample companies undertake sustainability practices just to fulfill customer or governmental requirements and do not adopt a proactive approach. This can be observed in the literature (Lee, 2008; Yeo Soo Wee, 2006) in which study was conducted on small and medium-sized suppliers of large MNCs where the primary focus was on profit maximization and sustainability received the least priority (Lee, 2008; Yeo Soo Wee, 2006).

Competitive strategy (CS) in this study refers to the company's efforts to consider sustainable practices as a cost reduction technique and a tool for competitive advantage. Results show a significant contribution of CS towards implementation of SPD, IGM, and IR. This is in line with the number of studies. SPD, IGM, and IR are important constituents of GSCM and studies highlight similar practices adopted by companies. Walker et al. (2008) mentions that companies include sustainability priorities in product development to gain a competitive advantage and companies with a desire for cost reduction undertake practices such as internal green initiatives, closed-loop recycling, and clearing of inventory and scraps (Carter & Dresner, 2001; Qinghua Zhu, Sarkis, & Lai, 2008a).

SPO refers to internal policy development and establishment of vision and objectives for sustainability. Results show a significant positive influence of SPO towards the implementation of most of the SSCM practices and is in line with existing literature. A highly significant influence of SPO on EP can be validated from past studies suggesting that EP involves the formulation of purchasing policies to enhance the environmental performance of the products procured and the supplier relationship (Zhang et al., 2016; Qinghua Zhu et al., 2008a). Therefore it can be derived that the establishment of purchasing policies is a necessary precursor to implementing environmental procurement practices. Furthermore, a significant association of SPO with EP is attributed to the literature where it is stated that companies develop internal sustainability policies with clear instructions for supplier-related transactions to implement SSCM practices (Walker et al., 2008). The association of SPO with the implementation of IR is an indication of top management commitment and organizational

support which can positively impact the implementation (Wu, Ding, & Chen, 2012). The association between SPO and ECC is validated by a number of studies. Vachon & Klassen (2008) state that environmental collaboration requires supply chain planning and the establishment of objectives for sustainability. B. Silvestre (2016); Zhang et al., (2016) demonstrate how companies with sustainability vision and objectives collaborate with their supply chain partners and other pioneer companies to achieve sustainability goals. The significant influence of SPO on SPD and IGM, can be validated from literature (Rao, 2002) which state that Internal green supply chain management practices (IGM and SPD) focus on achieving firm's specific internal target set by top management or enforced through company policies. Finally, a significant influence of SPO on DM and a relatively lower significant influence on CDI is observed. (Sancha et al., 2016) suggest that successful implementation of social initiatives requires the development of internal policies. Overall, results suggest that sustainability policies and objectives are very crucial in the successful implementation of TBL oriented sustainability practices in supply chain operations.

Government and institutional factors (Governmental support, Strict regulations, and Stringent administration) significantly influence the implementation of IGM whereas its impact on other practices is insignificant. An explanation for this could be that IGM corresponds to the supply chain operational goals of a company whereas other practices are connected to supply chain strategic goals. As these external bodies are mainly concerned about the operational sustainability of corporations, the companies might adopt Internal Green Management (IGM) activities to compline with the regulations and to obtain specific certifications. This observation aligns with the research study by Montabon, Melnyk, Sroufe, & Calantone (2000) where it is indicated that certification has a significant influence on green management practices of companies. Additionally, a number of studies indicate institutional regulations as an important driver for companies to undertake environmental management practices (K. Green et al., 1996; Walker et al., 2008). Another reasoning could be derived from literature Lee (2008), which claims that government support and involvement has a positive impact on SME supplier's green management and this study includes 22% SME's (less than 250 employees) in its sample as per the definition of the European Commission. It is rather interesting to see that GIF factors have no influence over the implementation of social sustainability practices (DM, SM, and CDI) which is contrary to the research findings of some

of the studies on social sustainability of SCM conducted in developing economy context (Mani & Gunasekaran, 2018; Morais & Silvestre, 2018).

Downstream supply chain factors (DSCF) include customer pressure, customer support, and consumer pressure. The sustainable practices which are mainly connected with these stakeholders are ECC, IR, and SPD. Surprisingly, DSCF has no significant influence on the implementation of these sustainability practices which is contrary to the literature (Ageron et al., 2012; Lee, 2008; Walker et al., 2008). Although, no significant influence is observed, around 40% of the sample companies have implemented these practices. Additionally, it can be observed from the descriptive analysis that companies face above-average influence from DSCF. One reason for this result could be that stable competition in the industry makes focal companies ignorant of the downstream supply chain factors in reference to the bargaining power theory of Porter (1980). Another reasoning is, DSCF has an indirect influence on the implementation of sustainable practices as it is observed from the correlation analysis, DSCF has a significant positive correlation with GIF, USCF, and CSI which are significantly associated with sustainability practices.

The upstream supply chain factors (USCF) considered in this study are supplier cooperation and supplier base. A high value of these factors represents supplier non-cooperation and limited supply base which affects the sustainability initiatives in the supply chain. Results indicate a significant negative contribution of USCF towards SPD, IGM, SM, and CDI. The negative relationship of USCF with SPD and IGM is in alignment with literature (Walker et al., 2008) where lack of supplier commitment and low supplier base has been identified as barriers to green supply chain management practices. Also, Vachon & Klassen (2008) suggested supplier collaboration practices for the implementation of GSCM practices in manufacturing plants and the above results confirm that supplier non-cooperation is a barrier to the implementation of practices. EP is primarily associated with suppliers and requires their cooperation. According to Zhang et al. (2016), EP is not just confined to direct suppliers but also considers environmental responsibility of second-tier suppliers. Current results indicate a non-significant influence of USCF on the implementation EP. A reasoning could be that sample company minimized the threat of supplier non-cooperation through efficient supplier management which involves activities such as strategic supplier selection and communication of sustainability requirements.

ECC and IR are basically concerned with downstream supply chain factors and non-significant influence of USCF on them is logical. Zhang et al. (2016) state that IR and ECC require a significant level of cooperation from customers. Furthermore, results indicate that with the increasing influence of USCF (non-cooperation and low supplier base), companies implementation of CSR practices such as SM and CDI decreases. This is natural, as the implementation of sustainability practices among suppliers is a complex task, and involves a large amount of information sharing and requires high coordination between these parties (Vachon & Klassen, 2006). On the other hand when the supply base is limited customer companies have low bargaining power (Porter, 1980) and may not want to enforce safety regulations on the suppliers. One of the reasoning for a negative relationship between USCF and CDI could be that, in case of limited suppliers, customer companies might be already maintaining a strong relationship with them and do not prefer spending additional resources on CDI activities.

A highly significant relationship between Corporate Social Image (CSI) and Community Development and Involvement (CDI) is in alignment with the literature. CSI in this study consists of factors such as public reputation and pressure from media and NGO's which are derived from the literature (Morais & Silvestre, 2018) which suggest that companies adopt social initiatives in their supply chain to enhance their public reputation and when they have pressure from secondary stakeholders such as NGO's and media. Furthermore, a relatively weak but significant relationship is also observed between CSI and DM. This means that sample companies concerned about CSI, undertake social initiatives. This is logical as most of the companies in this study are associated with products used in day-to-day life and they try to maintain a good corporate social image. Social image drives companies towards activities associated with enhancing social performance (Sancha et al., 2016). Surprisingly, a non-significant association of CSI with GSCM practices (SPD, IGM, EP, ECC, and IR) is observed which is contrary to the research findings of literature (Alzawawi, 2013; Trowbridge, 2001; Walker et al., 2008). It seems that sample companies are rather intrinsically motivated to undertake GSCM practices whereas external pressure in terms of public reputation, media and NGO's do not play a major role in this context.

Information and Supplier Management (ISM) significantly contribute to Sustainable Product Design (SPD) which is in line with the number of studies. Yeo Soo Wee (2006), suggests that

companies should design eco-friendly products to minimize the environmental impact of the product and this can be achieved by the establishment of the efficient information management system. Furthermore, supplier management in terms of clear communication of environmental requirements and strategic selection of suppliers is suggested for enhancing the environmental performance of the products being manufactured. Another study by Qinghua Zhu, Qu, Geng, & Fujita (2017) note that foreign customers of Chinese manufacturers require them to adopt eco-design to establish supplier relationships.

Surprisingly, a contradiction to the theory is observed with the results indicating a significant negative influence of Cross-functional collaboration and Risk Management (CRM) on practices such as SPD, IGM, and IR. According to Zhang et al. (2016), cross-functional collaborations facilitate IGM implementation and Bowen et al. (2001) consider cross-functional collaboration as a constituent of supply chain capabilities that lead to product based green supply chain. A reason for this effect could be the significant contribution of other organization related factors such as SPO, CS, and ISM towards implementation of GSCM practices. When these factors are in place, the top management may not prefer involving other cross-functions during the execution of the environmental project. However, a significant correlation between CRM and SPO, ISM, CS, indicate that cross-functional teams are associated with the development of policies, strategies and information management systems. Another reason for not including CRM during the execution phase is that companies employ a dedicated functional team to implement GSCM practices. Carter & Dresner (2001) highlights the past studies in which the majority of new product designs and innovations are initiated by R&D cross-function and claim that the same team tends to be involved with the success of environmental projects. Also, the companies may not prefer spending resources in terms of CRM activities for environmental and social concerns instead reserve them for economic issues.

On the other hand, a non-significant relationship between CRM and EP is in line with the previous study. Bowen et al. (2001) classify GSCM into a product and process GSCM and indicate the influence of CRM only on a product based GSCM. (A product based GSCM refers to activities that are related to products being manufactured, by-products and recycling, whereas process GSCM aims to enhance the environmental performance of the firm's relationship with suppliers). The current findings align with the above research implications as SPD, IGM, and IR are product based GSCM (related to the environmental performance of

the product, by-products, and recycling), whereas EP is a process-based GSCM as it greatly focuses on the environmental performance of supplier relationship.

Availability of Resources (AR) is a multidimensional factor consisting of Human, Technical and Financial resources. Higher influence of AR resembles a lack of resources and vice versa. The results indicate a significant negative influence of AR on SPD. This can be validated with literature (Bowen et al., 2001; Yeo Soo Wee, 2006) which indicate the importance of technical and human resources while undertaking product-based GSCM practices. Surprisingly, the non-significant relationship between AR and other green practices (EP, IGM, and IR) is contrary to the literature (Lee, 2008; Moktadir et al., 2018) highlighting the importance of the availability of resources in the implementation of green supply chain practices. A reasoning could be that the sample companies possessed suitable resources required for the implementation of these practices.

5.2.3 The relationship between factors and the level of implementation

5.2.3.1 Model description and compliance of assumptions

This section presents a description of the research model used in multiple regression analysis and associated assumptions. Next, it presents the outcomes of analysis followed by a discussion of results.

To investigate the effect of factors on the level of implementation and to make a comparison with binary logistic results, a multiple regression analysis was conducted with 10 predictor variables and 'Level of Implementation' as an outcome variable. As described earlier 'Level of implementation' is a variable that represents a total number of practices implemented by companies out of 8 management practices considered in this study. It doesn't measure the overall sustainability of companies as they might be engaged in some other practices that are out of the scope of this study. Descriptive statistics of the variables used in this regression is presented in section 5.2.1.

Table 5.12 presents the results of a multiple regression analysis. The model is highly significant with 52% of the variation in 'Level of implementation' explained by the predictor variables. The strength of the linear relationship is high with multiple R-value of 0.75. The assumption

of 'Errors in the regression are independent' is met as value lies between the value of 1 and 3 and close to 2 (Field, 2009). The assumption of 'no multicollinearity' is ensured as VIF of all the predictors are well below the value of 10 and tolerance level is above 0.2. The normal probability plot of residuals is close to a normal distribution and ensures normality assumptions of errors. The plot of ZRESID vs ZPRED has evenly dispersed dots indicating no threat of heteroscedasticity (Field, 2009). The plots are presented in Figure 5.4 and Figure 5.5.

N=112	Level of Implementaion						
	Coefficients		Correlations			Collinearity	
Factors	β	S.E	Zero-order	Partial	Part	Tolerance	VIF
TE	0.19^{+}	0.24	0.51	0.18	0.12	0.403	2.48
CS	0.12	0.25	0.46	0.14	0.09	0.53	1.89
SPO	0.55***	0.30	0.66	0.42	0.30	0.30	3.31
GIF	0.14^{+}	0.09	0.21	0.18	0.12	0.78	1.28
DSCF	-0.02	0.11	0.11	-0.03	-0.02	0.69	1.46
USCF	-0.20*	0.15	0.20	-0.23	-0.16	0.63	1.58
CSI	0.18*	0.11	0.40	0.22	0.15	0.715	1.40
ISM	0.18	0.10	0.58	0.16	0.11	0.38	2.64
CRM	-0.26*	0.14	0.44	-0.22	-0.15	0.343	2.92
AR	0.05	0.08	-0.09	0.07	0.05	0.85	1.18
F	12.78***						
R	0.75						
R^2	0.56						
Adjusted R^2	0.52						
Model $X^2(10)$	41.14						
Durbin-Watson	1.73						
*** $P < 0.001$, ** $P < 0.01$, * $P < 0.05$, $^{+}P < 0.10$							

Table 5.12 Results of multiple regression analysis

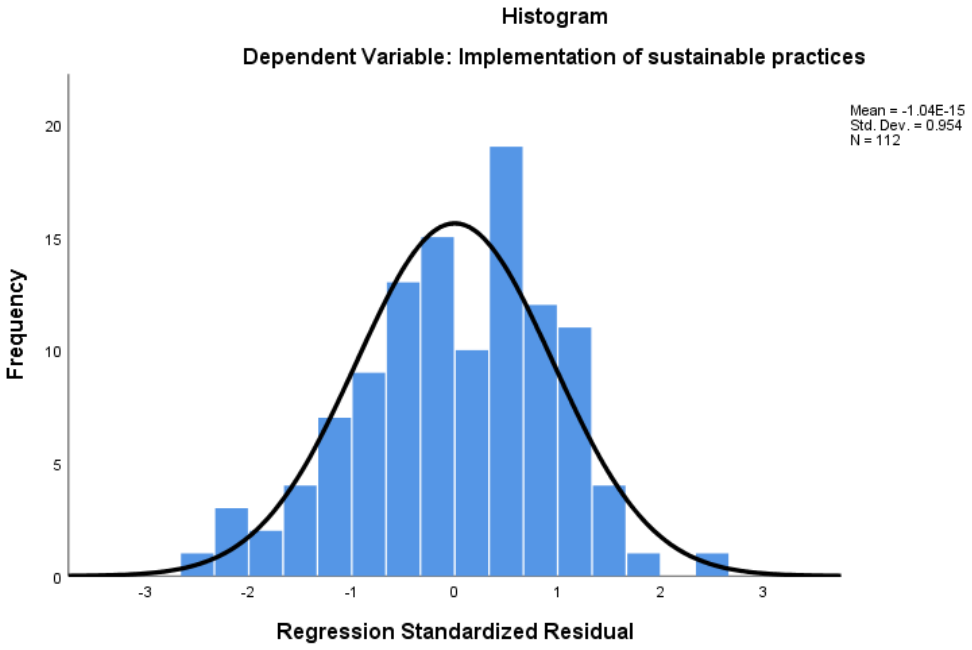

Figure 5.4 Normal probability plot

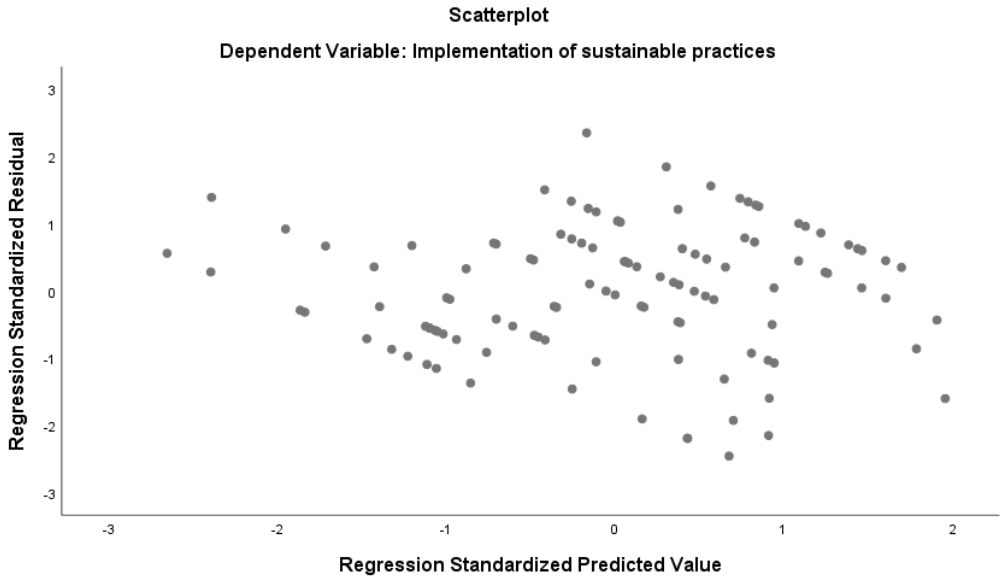

Figure 5.5 Scatterplot of ZRESID vs ZPRED

5.2.3.2 Discussion of results

SPO is a very strong predictor of the implementation of SSCM practices. This result suggests that the top management of sample companies strongly believe in the development of sustainability policies, vision, and objectives to achieve sustainability goals (Luthra & Mangla, 2018; Yeo Soo Wee, 2006). The significant influence of USCF highlights the importance of supplier cooperation and supplier base in the successful deployment of sustainability initiatives (Walker et al., 2008). Furthermore, CSI shows a significant positive influence on the level of implementation. The reasoning could be that companies are careful about how it is perceived by society and undertake sustainability initiatives to enhance their public reputation (Morais & Silvestre, 2018; Trowbridge, 2001; Walker et al., 2008). Surprisingly, CRM has a negative influence on the implementation of sustainable practices contrary to the studies suggesting their positive influence (Lee, 2008; Trowbridge, 2001). However, CRM has a positive influence on the level of implementation in zero-order correlation and relatively lower negative relationship in part correlation. The positive relationship in zero-order can be attributed to the reasoning provided in the previous section, that CRM activities can positively contribute to the implementation of sustainable practices when other factors are not acting upon. Part correlation (semi-partial) indicates the unique relationship of a predictor with an outcome variable when the influence of other predictors are controlled for (Field, 2009) and relatively lower negative influence (-0.15 compared to -0.26) of CRM in Part correlation indicates that any of the measurement items used to measure CRM (Cross-functional communication, cross-functional involvement, and monitoring product sustainability risks) might be positively associated with the implementation of SSCM practices. This reasoning can be validated from the research findings of Carter & Dresner (2001) which claims that the number of cross-functions involved has no influence on project success, however, the frequency of interaction has a positive influence on the success of the environmental projects. Therefore, it can be assumed that cross-functional communication has a positive influence on the implementation of SSCM practices. Finally, the lower significant influence of GIF and TE indicates that they influence only certain practices as seen in the previous section.

5.2.4 The comparison of results of two regression analysis and summary of results

Table 5.13 consolidates the results of both the regression analysis. An interesting observation is that, though CS significantly influences the implementation of 4 individual practices, it has no influence on the level of implementation. This suggests that companies that are highly driven by CS, implement selective practices. A similar observation can be made in case of ISM which significantly contributes to SPD but does not have any significant impact on other practices. This suggests that sample companies which implement Sustainable Product Design (SPD) are required to establish an efficient Information and supplier management system. DSCF has no significant influence on any of the sustainability practices whereas USCF influences 4 of the practices and the level of implementation. This indicates that DSCF does not directly contribute towards companies implementation of sustainability practices but may indirectly influence through other factors. On the other hand, companies experience a significant influence of supplier related factors (USCF) during the implementation of some of the sustainability practices. Finally, the sample companies faced significant influence of Availability of Resources (AR) only during SPD. The non-influence of AR on the level of implementation suggests that the sample companies possess enough resources to implement most of the sustainability practices.

N=112	Implementation of SSCM practices								
Influencing factors	SPD	IGM	EP	ECC	IR	DM	SM	CDI	Level of implementation
TE	x	x	x	x	x	x	x	*	+
CS	*	*	x	x	+	x	x	*	x
SPO	*	**	***	**	+	+	x	+	***
GIF	x	*	x	x	x	x	x	x	+
DSCF	x	x	x	x	x	x	x	x	x
USCF	*	**	x	x	x	x	*	*	*
CSI	x	x	x	x	x	+	x	**	*
ISM	*	x	x	x	x	x	x	x	x
CRM	*	*	x	x	+	x	x	x	*
AR	*	x	x	x	x	x	x	x	x
*** P< 0.001, ** P < 0.01, * P< 0.05, $^{+}$P< 0.10, X= Non-significance									

Table 5.13 Consolidated results of logistic and multiple regression analysis

Table 5.14 summarizes the findings from the data analysis. Additionally, it compares the results with the implications made in the existing literature. Descriptive evidence (DE) refers to an indication of significant influence in the literature, whereas Statistical significance (SS) indicates whether the significant influence of a factor on the implementation of sustainable practice is observed from the statistical analysis. It is observed that the significant influence of factors on some of the practices such as IR and DM is relatively low ($p<0.10$) and yet it is considered as this thesis aims to understand the influence of contextual factors in the fundamental sense.

Contextual factors	Implementation of SSCM practices															
	SPD		IGM		EP		ECC		IR		DM		SM		CDI	
	SS	DE	SS	DE	SS	DE	SS	DE	SS	DE	SS	DE	SS	DE	SS	DE
Training and Education (TE)	✗	✓	✗	✓	✗	✓	✗	✓	✗	✓	✗	✓	✗	✓	✓	✓
Competitive Strategy (CS)	✓	✓	✓	✓	✗	✓	✗	✗	✓	✓	✗	✓	✗	✓	✗	✓
Sustainability Policies and Objectives (SPO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✓	✗	✓
Government and Institutional Factors (GIF)	✗	✓	✓	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✓	✗	✓
Downstream Supply Chain Factors (DSCF)	✗	✓	✗	✗	✗	✓	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗
Upstream Supply Chain Factors (USCF)	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓	✗
Corporate Social Image (CSI)	✗	✓	✗	✓	✗	✓	✗	✓	✗	✓	✓	✓	✗	✓	✓	✓
Information and Supplier Management (ISM)	✓	✓	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Cross-functional collaboration and Risk Management (CRM)	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗
Availability of Resources (AR)	✓	✓	✗	✓	✗	✓	✗	✓	✗	✓	✗	✗	✗	✗	✗	✗
SS= Statistical Significance DE= Descriptive Evidence																

Table 5.14 Summary of results

Chapter 6. Conclusions

This section provides final remarks of the thesis project based on the research conducted. It is divided into three parts. The first part deals with general conclusion and answering of main and sub-research questions (6.1). The second part describes the research limitations encountered and suggestions for future research (6.2). The final part is dedicated to reflections and recommendations (6.3).

6.1 General conclusion and answers to research questions

6.1.1 General conclusion

Some of the existing studies have explored the drives and/or barriers to sustainability implementation and some others on strategies and sustainability practices of organizations. This study took a slightly different approach in the direction of SSCM. First, it derived a concrete set of SSCM practices based on existing literature and then empirically investigated the contextual factors contributing to the implementation of these practices in product manufacturing companies. What makes this research unique and important is it accounts for both environmental and social sustainability and it explores the influencing factors for each individual practices rather than considering SSCM as a whole.

Majority of sample companies were large-scale manufacturers of consumer products and reside in The Netherlands. The status quo of implementation of sustainability practices among sample companies was reasonably high considering the implications of low implementation in existing studies. Majority of the companies have implemented (or implementing) at least 4 out of 8 practices. This resembles a high awareness of sustainability pillars among organizational decision makers and society in general. The correlation analysis shows a high correlation between the implementation of IGSCM and EGSCM practices, which indicates that companies generally consider both internal and external green supply chain practices during the implementation of GSCM.

To achieve the research objective, the main research question and 2 sub-research questions were formulated. A comprehensive literature survey yielded answers to sub-research questions and development of research measurement model, thereby driving one step closer to answering the main research question. Statistical analysis (binary logistic regression and multiple regression) performed on data of 112 companies, lead to interesting results. The analysis of results and its comparison with existing literature provided an answer to the main research question.

6.1.2 Answers to main and sub-research questions

As sub-research questions (RQ1 and RQ2) are building blocks of the main research question (RQ), answers to the sub-research question are presented first followed by answering the main research question.

RQ1: What are the different management practices that contribute to environmental and social sustainability in manufacturing SCM?

Discussion:

A comprehensive literature survey was conducted to tackle this question which resulted in the identification of eight management practices that are strongly associated with SSCM. These eight management practices are suitable for manufacturing industry and are empirically tested previously by Zhang et al. (2016) with the data from 293 manufacturing companies. Additionally, these practices are focused on the environmental and social pillars of sustainability which aligns with the research objective.

Answer:

The eight practices are identified under 3 main dimensions which are Internal Green Supply Chain Management (IGSCM), External Green Supply Chain Management (EGSCM), and Corporate Social Responsibility (CSR). IGSCM and EGSCM strive to bring about environmental sustainability in the manufacturing supply chain whereas CSR focuses on social sustainability.

IGSCM corresponds to environmental initiatives within an organizational boundary and it includes two practices under it namely, Sustainable Product Design (SPD) and Internal Green

Management (IGM). SPD mainly deals with designing an environmentally sustainable product which is made from green materials, consumes less energy and are recyclable. IGM focus on achieving environmental excellence internally and shows the green commitment of management.

EGSCM reflects on environmental sustainability practices undertaken by companies in close relationship with primary stakeholders outside the firm's boundary such as customers, suppliers, and consumers. It includes practices such as Environmental Procurement (EP), Environmental Customer Collaboration (ECC) and Investment Recovery (IR). EP focus on enhancing the environmental performance of the supply chain through supplier relationship and includes concepts such as eco-labels of procured materials, avoiding procurement of environmentally hazardous materials, recyclability of supplied materials and environmental responsibilities of suppliers. ECC refers to collaboration with customers to manage the environmental performance of the production, packaging, and maximization of logistics resources. IR is based on the concept of circular economy or closed loop supply chain but it also involves some other aspects such as clearing of surplus inventory and scrap.

CSR in this context aims to bring about social sustainability in SCM and includes practices such as Diversity Management (DM), Safety Management (SM) and Community Development and Involvement (CDI). DM involves activities such as purchasing from minority and women based enterprise, contacting with minority-based companies, appointing and promotion of women executives. SM basically deals with precautions to ensure health and safety of all the employees, safety practices in warehouses and among suppliers. CDI shows the company's efforts towards supporting the local community and also a specific form of involvement.

Due to the strong association with environmental and social pillars of sustainability, IGM, SPD, EP, ECC, IR, SM, DM and CDI are the eight management practices considered in this study.

RQ2: What are the different factors of sustainability implementation, that can be derived from literature survey?

Discussion:

Survey of the existing body of relevant literature resulted in the identification of five main categories of factors that are suggested to play a crucial role in the implementation of SSCM.

A further analysis (PCA) of two of the five main factors resulted in 7 new factors. Since this study aims to understand the implementation of sustainability practices in a very fundamental sense, all the 10 factors were used in the analysis to explore their influence on the implementation of each of the practices.

Answer:

Various factors of sustainability implementation that can be derived from the literature survey are Training & Education (TE), Competitive Strategy (CS), Government & Institutional Factors (GIF), Upstream Supply Chain Factors (USCF), Downstream Supply Chain Factors (DSCF), Corporate Social Image (CSI), Information and Supplier Management (ISM), Cross-functional Collaboration and Risk Management (CRM) and Sustainability Policies & Objectives (SPO).

The main research question:

RQ: What are the factors that significantly influence the implementation of sustainable supply chain practices corresponding to environmental and social pillars, in product manufacturing companies of the BENELUX region?

Discussion:

Regression analysis shows a different set of factors contributing towards the implementation of each sustainability practices. However, certain factors are common contributors to the practices that are inter-related. This can be validated from a research study by Qinghua Zhu et al. (2007) which suggests that decomposition of GSCM practices (SPD, IGM, EP, ECC, and IR) is a complex task as they are interconnected. The factors influencing the implementation of individual practices are presented below. Additionally, the influencing factors for the level of implementation were also explored.

Answer:

Overall, Sustainability Policies and Objectives (SPO) is a strong predictor among the factors as it contributes to the implementation of most of the practices. SPO shows highly significant influence on all the GSCM practices. Companies achieve their environmental sustainability goals through internal policy development and establishment of vision and objectives for sustainability. Additionally, the inclusion of social priorities in sustainability policies and

objectives have some level of influence on the implementation of CDI and DM. This suggests that top management commitment to sustainability is generally high and they include sustainability priorities in policies and objectives.

A sustainability-oriented competitive strategy significantly influences the firm's decision to implement SPD, IGM, and IR. Companies consider Sustainable Product Design (SPD) as a potential tool to gain a competitive advantage and its desire to reduce cost drives them towards the implementation of practices such as IGM and IR. These costs may not be only direct costs but also include hidden costs (Walker et al., 2008). On the other hand, CS has no direct influence on the implementation of social sustainability practices.

Corporate Social Image (CSI) significantly influences the implementation of social sustainability practices such as CDI and DM. This indicates that companies try to enhance their public reputation by undertaking these social initiatives. Also, when the pressure from secondary stakeholders such as media and NGO's is high, companies face threat to their public reputation and engage in social initiatives.

Influence of Government and institutional factors is observed only on the implementation of IGM. This indicates that government and institutional factors are only concerned with the environmental performance of the company whereas its support and pressure towards company's social sustainability efforts are insignificant. The downstream supply chain factors (DSCF) has no significant influence on the implementation of any sustainability practices in this context. However, DSCF shows a significant correlation with Corporate Social Image (CSI) which in turn contributes to the implementation of social practices. This indicates that when consumer pressure is high, companies work toward maintaining their Corporate image.

It is observed that training & education programs significantly influence a company's implementation of CDI. This indicates that companies use training & education programs to educate the employees about the sustainability issues outside a firm's boundary and enhance its social initiatives. Additionally, companies enhance their social involvement through training & education programs to the suppliers.

Information and Supplier Management (ISM) significantly contribute to the implementation of Sustainable Product Design (SPD). It indicates that when companies establish an efficient information management system to assess the environmental information of the product

throughout its life-cycle and conduct periodic environmental audits to monitor the firm's environmental performance it is more likely to adopt Sustainable Product Design (SPD).

In this context, the Upstream Supply Chain Factors (USCF) shows significant negative influence on the implementation of SPD, IGM, SM, and CDI. This signifies the importance of supplier base and supplier cooperation in the successful implementation of sustainability practices. With the increasing pressure of supplier cooperation and supply base, companies are less likely to adopt a Sustainable Product Design (SPD) as it requires suitable suppliers and their cooperation in supplying right kind of materials. IGM basically reflects the commitment of top management towards the adoption of green practices and they are less likely to make changes to their current policies or establish supply chain related sustainability objectives when the pressure of USCF is high. On the other hand, companies are less likely to implement safety management systems among suppliers and less likely to engage in CDI activities when they have low supplier base and low supplier cooperation.

Cross-functional collaboration and Risk Management (CRM) shows a significant negative influence on the implementation of SPD, IGM, and IR. However, CRM shows a significant positive correlation with SPO, CS, and ISM. This suggests that CRM is associated with the development of sustainability policies, strategies and the establishment of information management systems, whereas CRM is not employed during the project execution phase. It is suspected that companies do not prefer CRM activities for environmental and social issues but restrict them to economic concerns.

The pressure of Availability of Resources (AR) negatively contributes towards the implementation of SPD. Companies that lack human, technical and financial resources face high influence of AR and are less likely to opt for Sustainable Product Design(SPD). This result highly signifies the importance of human, technical and financial resources for designing an innovative eco-friendly product.

A multiple regression conducted to explore the influence of factors on the level of implementation suggest that SPO and CSI has a significant positive influence on the level of implementation whereas USCF and CRM have a significant negative influence. Companies that show high efforts towards the development of SPO and driven by CSI are likely to adopt most of the practices considered in this study. However, the pressure of USCF is likely to

impact the company's sustainability initiatives. CRM efforts contribute to the formation of sustainability policies and strategies in general but do not positively contribute to the level of implementation of environmental and social sustainability practices. A relatively low significant influence of GIF and TE observed towards the implementation of sustainability practices suggest that they influence only specific sustainability practices.

6.2 Limitations and suggestions for future research

This section presents the limitations of this research and potential directions for future research. Some research limitations were observed during the data collection and data analysis phase which generated ideas about how future studies could be structured to further enrich the knowledge in this field.

6.2.1 Limitations

Sample size:

The size of the sample always plays a crucial role when statistical research techniques are employed. This study considered a sample size of 100 as a minimum requirement to initiate the data analysis considering the practical difficulties and time-frame. Though the sample size of 112 is just sufficient, a large sample would result in greater generalisability of the model. The requirement of survey response from a senior personnel of the company further contributes to the practical difficulties.

Measurement of Implementation:

This survey measures the implementation of sustainability practices on a dichotomous scale which limits accurate measurement of implementation of sustainability practices. Alternatively, a detailed multi-item scale could have been used to measure the level of implementation of each of the sustainability practices. Since there were 8 different practices a dichotomous scale was used to tackle the practical difficulties associated with the data collection.

Sample characteristics:

This study focuses on all types of product manufacturing companies to achieve a sufficient sample size. This may limit the applicability of research implications to a certain specific type of product manufacturing companies. Though the majority of the companies belong to The Netherlands, the sample also includes some companies from Belgium and Luxemburg. This moves the research applicability from country context to region context.

Regression method:

Since a binary logistics regression estimates the odds of outcome variable being true or false (1 or 0) from the set of predictors, it requires close to equal proportions of both the cases (1's and 0's). However, dis-proportion between implementation and non-implementation was observed for practices IR, DM & SM. In this scenario, the logistic regression model cannot explain most of the variations in the outcome variable. This corresponds to a lower R^2 value for IR, DM, and SM. Additionally, predictive accuracy test (Chi-Square) requires a uniform distribution of 1's and 0's among the sample and therefore a higher sample size is recommended (Hair et al., 2010). This corresponds to relatively low significance of predictive accuracy for IR. Table 6.1 and Table 6.2 highlights the limitations associated with the logistic regression model used in this study.

Practices	SPD	IGM	EP	ECC	IR	DM	SM	CDI
Yes	60	62	61	52	40	38	86	61
No	52	50	51	60	72	74	26	51
Yes %	54%	55%	54%	46%	36%	34%	77%	54%
No %	46%	45%	46%	54%	64%	66%	23%	46%
Mean	0.54	0.55	0.54	0.46	0.36	0.34	0.77	0.54
Min	0	0	0	0	0	0	0	0
Max	1	1	1	1	1	1	1	1
N=112 Yes= Implemented No= Not implemented								

Table 6.1 Limitation of the model (1)

Practices N=112	SPD	IGM	EP	ECC	IR	DM	SM	CDI
Cox & Snell R^2	0.39	0.37	0.40	0.33	0.14	0.22	0.25	0.48
Nagelkerke R^2	0.51	0.50	0.54	0.45	0.19	0.30	0.37	0.36
Model $X^2(10)$	54.39***	52.21***	57.32***	45.34***	16.62^{+}	27.05**	31.82***	50.11***
*** $P<0.001$, ** $P<0.01$, * $P<0.05$, $^{+}P<0.10$								

Table 6.2 Limitation of the model (2)

6.2.2 Recommendations for future research

This study provides fundamental knowledge about the implementation of environmental and social sustainability practices and associated factors in a certain context. Several paths could be taken in the same direction in future studies.

The future studies should consider a detailed measurement scale for measuring the implementation of SSCM practices. A multi-item measurement scale would give a better picture of the implementation of sustainability practices by industries. Some useful insights for constructing such a measurement scale could be gathered from (Morais & Silvestre, 2018; Qinghua Zhu et al., 2008b). Once the detailed measurement model is set up different approaches could be followed. Some of the approaches are, to measure the level of implementation of environmental and social sustainability practices in a specific industry context or to measure the impact of environmental and social sustainability implementation on the economic performance of the companies.

This study gives the basic idea about different types of factors that play a role during the implementation of sustainable practices. However, the interaction among the factors may exist. Future studies could focus on only a specific type of factors such as internal/external factors, Organizational factors, or stakeholder related factors. Additionally, there might be additional factors of implementation not considered in this study and could be explored and included in the measurement model.

This study is conducted in a specific region and general product manufacturing company context. Studies should be conducted in a precise context such as a specific type of product manufacturing company. This gives a more clear picture of the influencing factor for the specific industry. Also, future researchers could think of breaking down the research scope into either environmental or social sustainability to avoid the threat of low sample size and enable precise measurement.

Building from this research study, future studies can consider a case study analysis or interview research studies to further validate the research findings in a particular company context. Sometimes the survey responses are subjected to a response bias as it takes self-assessment as the responses and case study eliminates this threat as it involves scrutinizing

annual reports of companies. Also, similar studies should be conducted in different country context to broaden the knowledge base.

6.3 Reflection and recommendation

6.3.1 Personal reflection

This study was primarily conducted to better understand the implementation of environmental and social sustainability practices in SCM. Research objective has been met to a substantial degree. Due to low sample size research could not explain much about factors influencing social practices. However, various influencing factors have been identified which significantly contribute towards the successful implementation of sustainability practices.

Overall, sustainability policies and objectives have been identified as a major contributor to the implementation of practices. Companies that show high efforts towards the development of objectives and policies are more likely to implement environmental and social sustainability practices. Additionally, corporate social image and competitive strategies drive companies toward implementation of specific sustainability practices.

It is observed that the availability of resources was not a major issue for the implementation of practices except for the SPD. In addition, an efficient information and supplier management system strongly contribute to the implementation of SPD which indicates that adoption of sustainable product design requires substantial resources and proactiveness.

Influence of Government and institutional factors in this context is limited to environmental compliance and do not contribute to social sustainability efforts. In order to enhance the implementation of social practices by manufacturing companies, government and institutions need to take a proactive approach and allocate incentives to drive companies towards them. The pressure of supplier cooperation and supplier base strongly influences the implementation of sustainability practices. The influence of downstream supply chain factors is insignificant in this context. Lastly, CRM has a negative influence on the implementation of product based GSCM practices and no influence on process-based GSCM practices. However, companies can achieve higher organizational support for the successful implementation of

sustainability practices through enhanced cross-functional communication of sustainability issues (Carter & Dresner, 2001).

6.3.2 Managerial implication

In general, the contextual factors identified through research findings are expected to aid industrial decision makers during the implementation of sustainability in their respective organization. Additionally, it provides an opportunity to compare and calibrate their level of implementation with that of the industry.

The first and foremost takeaway message from this study to decision makers is to understand the potential of sustainability objectives and policies. Through strong policies and objectives, managers can establish sustainability culture in the organization and enhance the organizational support in achieving environmental and social sustainability goals.

Sustainable product design and Internal green management are seen as a potential tool to gain a competitive advantage and reduce costs. Managers need to understand the importance of Information and supplier management in this regard. An efficient Information management systems will generate manager awareness regarding the environmental issues and guide them towards necessary actions. On the other hand, better supplier management in terms of strategic supplier selection and communication of environmental requirements to suppliers will minimize the influence of supplier non-cooperation and limited supply base.

Non-availability of resources significantly affects green initiatives such as sustainable product design. Therefore managers need to ensure the availability of sufficient human, technical and financial resources for successful implementation.

6.3.3 Scientific relevance

This research study undertaken is one of its kind in its approach and in the context it was performed. Though several studies have been conducted in the past corresponding to the domain of SSCM, none of the studies explore influencing factors for the implementation of individual environmental and social sustainability practices of manufacturing SCM.

This study is built upon the frameworks of a number of past studies and is a connecting link between them (Carter & Dresner, 2001; Walker et al., 2008; Zhang et al., 2016; Qinghua Zhu et al., 2008b). Moreover, this study performs an empirical analysis contrary to many of the existing studies which either opt for case study analysis (Mangla et al., 2018; Morais & Silvestre, 2018; Trowbridge, 2001; Walker et al., 2008) or qualitative research approach (Agyemang et al., 2018; S Seuring, 2013). Though this study faces the issue of sample size for explaining factors of implementation for three of the sustainability practices, overall it attains satisfactory results. The research findings are expected to broaden the understanding of environmental and social sustainability implementation in the context of BENELUX.

The study provides useful information for industrial decision makers who are aiming to implement any of the sustainability practices considered in the study. At the same time, it provides useful insights for future researchers in this direction

6.3.4 Faculty (MOT) relevance

This research study is considered to be relevant to the faculty of Technology, Strategy, and Management (TPM) and the master of Management of Technology (MOT) to which the author is enrolled.

This study is associated with a number of study courses introduced during the 2 years of master course. It involves aspects of study courses such as Technology, Strategy, and Entrepreneurship (in understanding how firm's competitive strategy depends on its external stakeholders and bargaining power theory of porter), Technology Dynamics (in understanding the importance of sustainability in business operations), Business Process Management (in understanding how business operations can be optimized), Research methods (Greatly contributes towards knowledge of statistical methods and analysis) and Preparation to master thesis (in understanding basic aspects of research project). Additionally, this study is in alignment with the master specialization of Supply Chain Management provided in the second year of master's course. The knowledge generated through this research study is expected to be helpful if the SSCM topic is introduced in the future study courses of Supply Chain Management specialization. Finally, this study is relevant to the faculty of Technology,

Policy, and Management, as it involves aspects of policies and management. Research findings are expected to contribute to the development of sustainable policies to promote sustainable supply chain management.

Suggestions for the Master's course:

Looking back at the master's course of MOT, it is a highly educative master's course with a perfect blend of technology and management. However, some adaptations could be thought of. Firstly, topics such as SSCM, operations management, industry 4.0 and blockchain integrated SCM could be added to the curriculum as these are the emerging topics in the present industry scenario. Apart from specialization courses, not much focus is shed on topics of SCM during first year MOT courses, even though operations management and SCM are considered to be a key functional area of businesses. Another suggestion is to guide the student to identify and finalize his/her master thesis topic before the start of the course 'Preparation to master thesis'. This will help the student to better understand academic research and undertake concrete research project. One potential idea to achieve this is by assigning study advisors to each student who can guide the student towards suitable supervisors based on his/her area of interest.

Chapter 7. Bibliography

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Appendix

Questionnaire for the industry survey

Contextual factors influencing the implementation of sustainability practices in Manufacturing Supply Chain Management

Preamble

Dear participant,

First of all, I would like to thank you sincerely for taking up this survey. You are now one among many who are helping to achieve objectives of this thesis. Your contribution is valuable!
To set up the stage, this research aims to explore the factors that play a role while implementing environmental and social sustainability practices into the supply chain of manufacturing companies. There are eight different management practices that lead to environmental and social sustainability in supply chain management. Existing literature suggests various factors to have an influence on sustainability implementation. Through this survey, we try to explore which of the factors have an influence on your organization. The outcomes of the research will aid industrial decision makers, to understand the different factors that are to be addressed while implementing sustainable practices in SCM.

Because you are the one who can give us a correct picture of how things run in industries, I request you to answer the questionnaires **honestly and best to your knowledge**. The data provided by you will be **strictly confidential**. Only the members of the research committee will be able to access the data given by you. Additionally, the final thesis report will include statistical summaries derived from data of all the respondents and not from an individual organization's data.

Finally, you have an opportunity to receive the research findings by marking for 'receive thesis outcomes' field, which can be found at the end of the survey. I highly appreciate your cooperation. In case you have any questions about the project or survey questionnaires, do not hesitate to reach out to me.

Thank you!

Sincerely,

M.S.BHAT (MSc researcher)
Email: M.S.BHAT@student.tudelft.nl

Details of the committee

Prof. Dr. Ir. Lorant Tavasszy (Chair of the research project)
Dr.Jafar Rezaei (First supervisor of the research project)
Dr.Geerten van de Kaa (Second supervisor of the research project)

Part A
Management practices of SSCM

Sustainable Supply Chain Management (SSCM) is defined as "*the strategic, transparent integration and achievement of an organization's social, environmental, and economic goals in the systemic coordination of key inter-organizational business processes for improving the long-term economic performance of the individual company and its supply chains*" (Carter & Rogers, 2008, p.368).

This thesis takes into consideration eight different management practices that are empirically proved to be associated with SSCM.

In the next section, you will read about eight practices and their definitions. Please select practice(s) relevant to your organization.

(Note: Multiple selections possible)

Sustainable Product Design (SPD) [SPD is one of the important dimension and it refers to sustainable and eco-friendly product design. It is also referred as ''Design for environment'' and defined as "*the systematic integration of environmental consideration into the product and process design*"(CIBSE (Chartered Institution Building Services Engineers), 2006; Zhang et al., 2016).] It basically involves environmentally friendly design (use of green materials, less consumption of energy and resources, and recyclable)	☐
Internal Green Management (IGM) [IGM reflects the activities undertaken in order to promote and commit to the green practices and is defined as *''the practice of improving environmental excellence internally through management commitment, employee training, organizational regulation, and cross-functional collaborations*'' (Zhang et al., 2016).] It basically tries to achieve environmental excellance internally and reflects on green commitment of the management	☐
Environmental Procurement (EP) [It basically deals with concepts like Eco-labels, avoidance of environmentally hazardous material and reusability of supplied materials. EP is defined as "*the set of purchasing policies held, actions taken, and supplier relationships formed in response to concerns associated with the natural environment*" (Zsidisin & Siferd, 2001, p.69).] It involves aspects of eco-labels, Avoidance of environmentally hazardous material, recyclability of supplied materials and environmental responsibility of suppliers.	☐
Environmental Customer Collaboration (ECC) [ECC refers to environmental efforts of supply chain activity external to the firm boundary and focuses on collaboration with customers to achieve sustainability goals (Zhang et al., 2016).]	☐

It tries cooperate with customers to environmentally manage production, flow of materials (green packaging) and optimization of logistic resources	
Investment Recovery (IC) [Investment Recovery (IR) is defined as "*management practices that recover and recapture the value of unused or end-of-life assets through sales of excess inventories, scrap and used materials, excess capital equipment, and refurbished products*" (Zhang et al., 2016; Qinghua Zhu et al., 2008b).] It is based on concepts of circular aconomy or closed loop supply chain, however it has additional element of minimizing unnecessary inventory and scraps	☐
Diversity Management (DM) [DM reflects activities focused on promoting equality by purchasing from minority-owned enterprises. It can be implemented by the appointment of minority and women employees, uplifting and contracting with the minority-owned business enterprise as suppliers (Inoue & Lee, 2011)].	☐
Safety Management (SM) [SM deals with promoting safety considerations into the supply chain (Zhang et al., 2016) and reflects on promoting the health and safety of the employees. Furthermore, Safety practices among suppliers, safety precautions and safety practices in warehousing are crucial (Ciliberti, Pontrandolfo, & Scozzi, 2008).]	☐
Community Development and Involvement (CDI) [Community development and involvement reflect on the company's efforts to contribute, develop and support the local communities and also its social involvement (Zhang et al., 2016). CDI is an important part of CSR and it positively reflects the company's efforts towards social welfare and social concern.]	☐

Note: Your company might be engaged in practices that matches the description but may have different tittle. In that scenario you may select the relevant practice.

Which of these **practices** are implemented and/or being implemented in your organization?
(Multiple selection is possible)

P1
P2
P3
P4
P5
P6
P7
P8
None

Part B

Factors of Sustainability Implementation

There are many different factors which influence the adoption of sustainability practices in an organization. In this research, we consider a set of factors and their sub-factors that are implicated to play role in the existing literature. These factors are categorized into five main groups namely, Training & Education, Competition, Stakeholders, Supply Chain readiness & capabilities and organizational ethics & values. These factors are gathered from multiple industry contexts and may have an influence in your industry context.

The following section unfolds the questions directed towards factors and sub-factors considered in this research. **Please answer these questions honestly considering your organization's scenario.**

To what extent your company organizes supply chain sustainability-related training & education programs for **employees**?

Low Very	Low	Moderate	High	Very High

To what extent your company organizes supply chain sustainability-related training & education programs for **suppliers**?

Low Very	Low	Moderate	High	Very High

To what extent your organization focuses on '**implementation of sustainable practices**' as a potential tool for **competitive advantage**?

Low Very	Low	Moderate	High	Very High

To what extent your organization focuses on '**implementation of sustainable practices**' as a **cost-reduction technique**?

Low Very	Low	Moderate	High	Very High

What is the influence of below stakeholder related factors on your **company's decision** on sustainability implementation?

Factors	Low Very	Low	Moderate	High	Very High
Customer Pressure					
Customer Support					
Supplier Cooperation					
Consumer Pressure					
Supplier Base					
Governmental Support (E.g. Tax reduction, subsidies etc.)					
Strict Regulations					
Stringent Administration of agencies					
Public Reputation					
Pressure from media & NGO's					

How do you describe your company's efforts to establish an '**Information management system**' to collect and maintain **environmental information**?

Low Very	Low	Moderate	High	Very High

To what extent your organization conducts environmental **audits** to monitor the **environmental performance** of the firm?

Low Very	Low	Moderate	High	Very High

To what extent your company's implementation of sustainability practices is/was affected by the **availability of resources**?

Resource	Low Very	Low	Moderate	High	Very High
Human (Ex: Availability of skilled SCM personnel)					
Technical (Ex: Availability of better technology to operate sustainably)					

Financial					

Ex:
Very Low = Availability of resources was not an issue
Very High= Due to unavailability of resources, company could not implement sustainability practices

How do you describe your company's efforts in **cross-functional communication** of sustainability issues?
(Note: Cross-function refers to different departments of the company)

Low Very	Low	Moderate	High	Very High

To what extent your organization involve employees from other **cross-functions** while **designing** supply chain strategies?

Low Very	Low	Moderate	High	Very High

To what extent your company considers the 'environmental performance' of the supplier as a **criterion for supplier selection**?

Low Very	Low	Moderate	High	Very High

To what extent your company communicates environmental sustainability requirements to the supplier?

Low Very	Low	Moderate	High	Very High

To what extent your company involves important suppliers during the product development phase?

Low Very	Low	Moderate	High	Very High

With respect to **Risk Management,** to what extent your organization monitors sustainability related risks of the product?

Low Very	Low	Moderate	High	Very High

How do you describe your company's efforts towards internal 'sustainability policy development'?
(Note: Sustainability policies include a clear set of rules, procedures, and guidelines for sustainable operations)

Low Very	Low	Moderate	High	Very High

How do you describe your company's efforts towards the 'establishment of vision and objectives for sustainability'?

Low Very	Low	Moderate	High	Very High

Part C

Company profile

Please be assured that the information you provide under this section will be kept strictly confidential. This information is required in order to sort the data into relevant category such as small, medium or large manufacturing companies. Additionally, this data will enable the researcher to justify that diversity among respondents have been considered.

Which type of product manufacturing industry your company belongs to?
(Multiple selections possible)

Electricals & Electronics	
Metal Manufacturing	
Medical Devices	
Machinery Manufacturer	
Consumer Goods	
Food & Beverages	
Automotive	
Others- Please specify	

Please indicate the approximate number of employees in your organization

1-9	
10-49	
50-99	
100-249	
250-499	
500 and More	

Please indicate your company's average turnover (last 2-3 years)
(Note: Please consider current exchange rate if currency is other than US dollars)

Less than 10 Million dollars	
Between 10-20 Million dollars	
20-30 Million dollars	
30-40 Million dollars	
40-50 Million dollars	
Above 50 million dollars	

What is your title in the company you presently working with?

Junior engineer or equivalent	
Senior engineer or equivalent	
Assistant manager or equivalent	
Mid-level engineer or equivalent	
Top level manager or equivalent	
Board of director, decision maker or equivalent	

What is your experience level in the company/industry?

Context	0-3 years	4-6 years	7-10 years	11-15 years	16-20 years	Above 20 years
Present organization						
Manufacturing industry						

Do you wish to receive research findings?

Yes O
No O